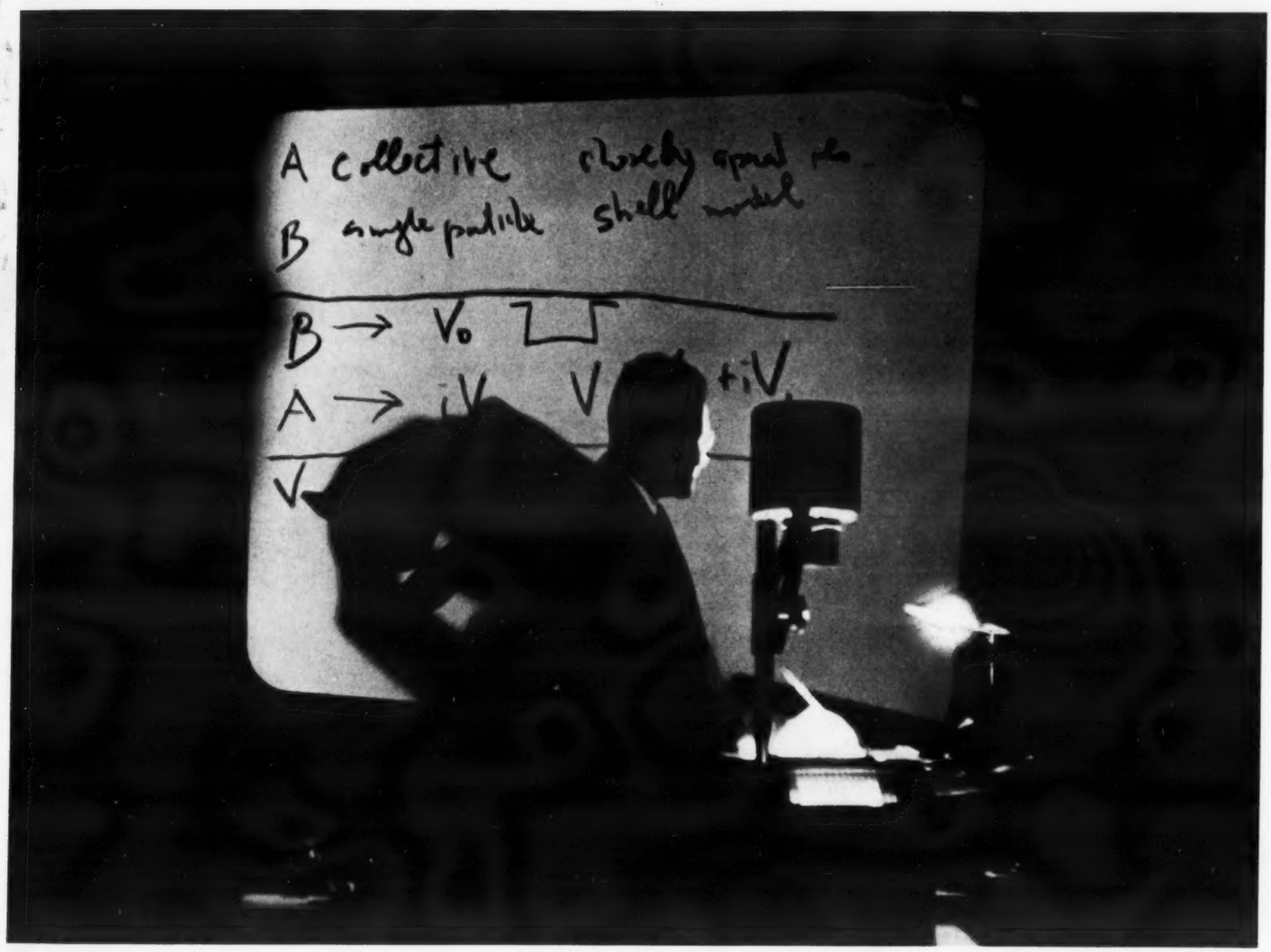
INTERAVIA

REVIEW OF WORLD AVIATION



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IN THIS ISSUE

"Atoms for Peace"

Ten Years in British Aviation

VOLUME X 11 NOVEMBER 1955

DEUCE- the digital computer with unequalled aircraft industry 'experience'

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INTERAVIA

Review of World Aviation

Volume X | No. 11 | November 1955

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Front Cover :
" Atoms for Peace ", or the new " Black Magic " : At the Geneva Conference U.S. Atomic Scientist Victor F. Weisskopf of M.I.T. draws on equation into an epidiascope which simultaneously projects his writing and his hand on to a screen. — Photo : United Nations.

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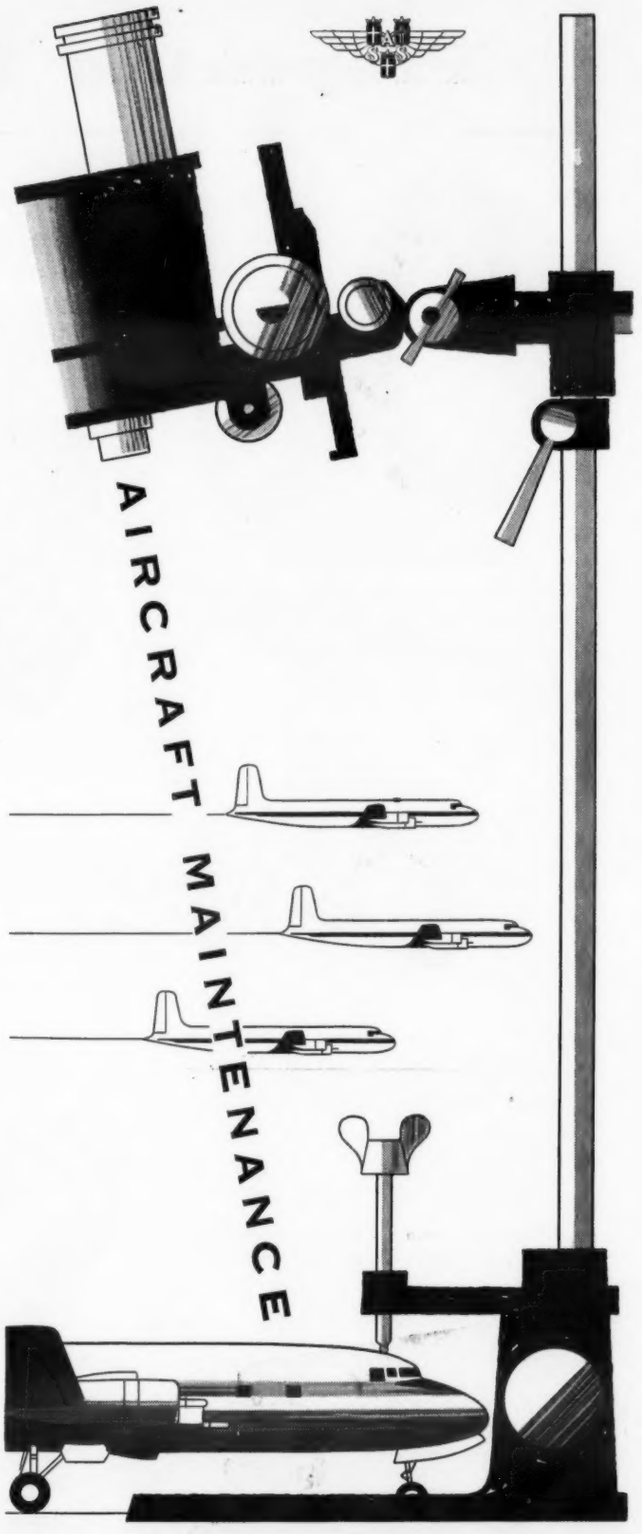

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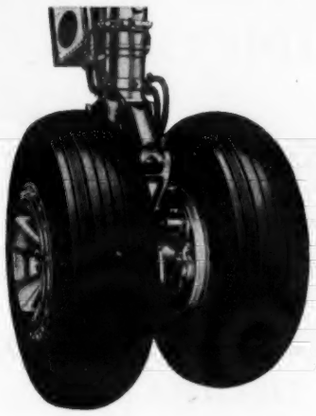

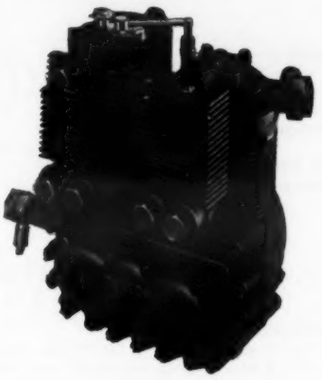

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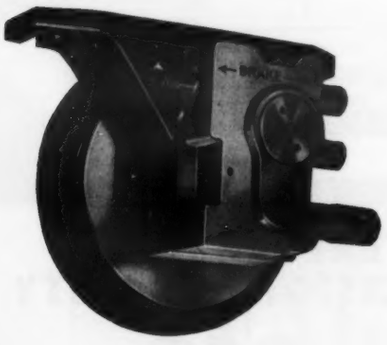

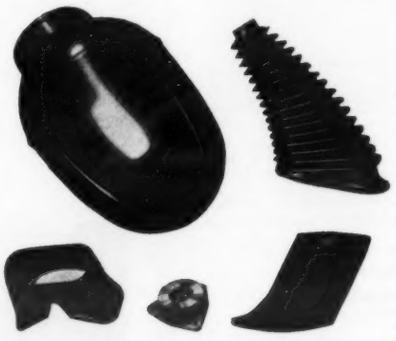

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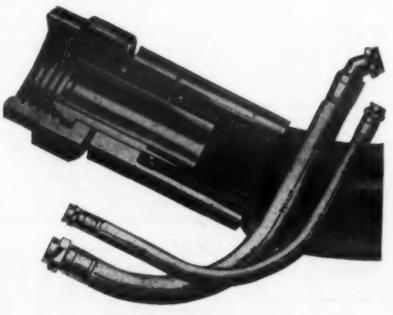

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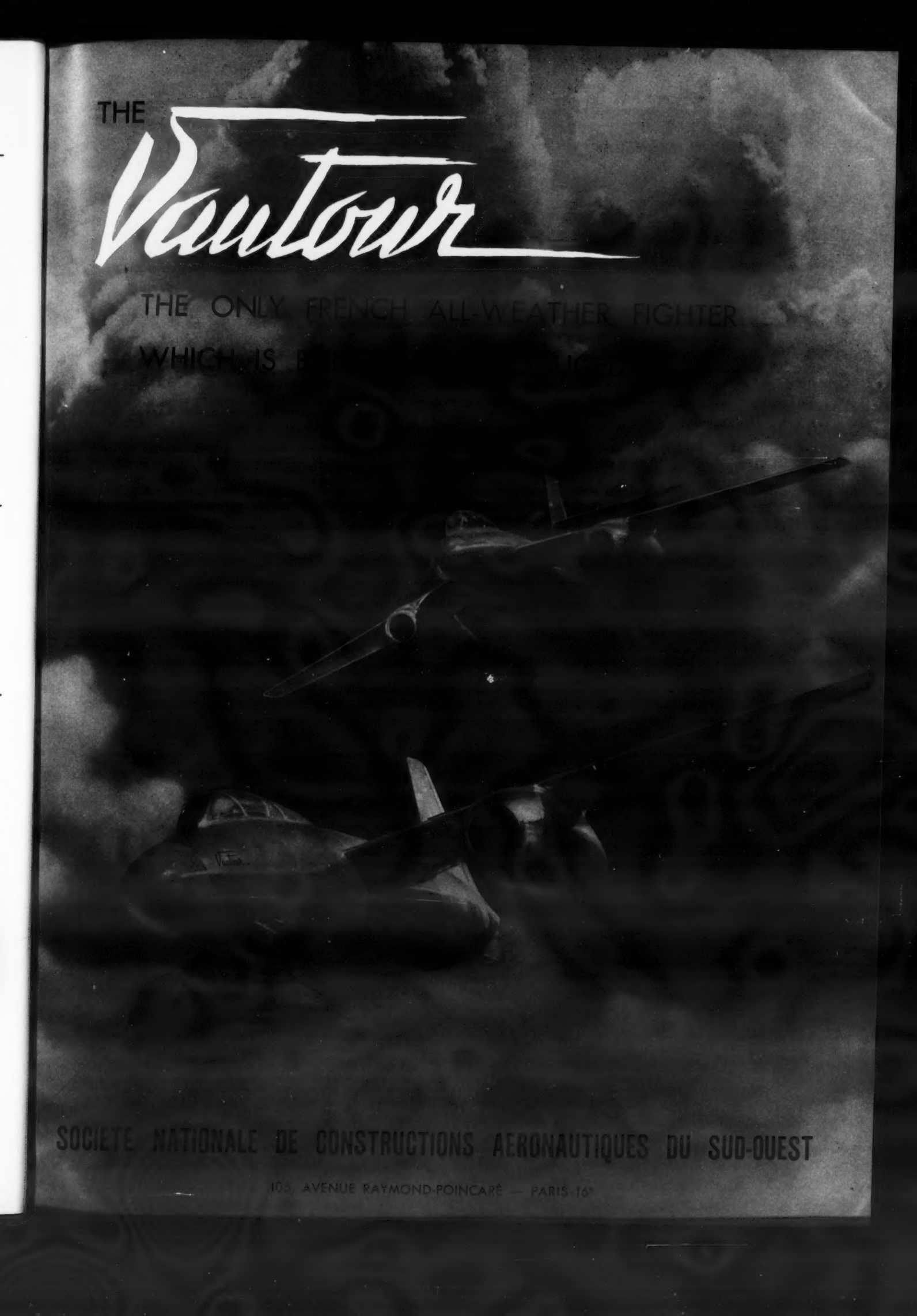
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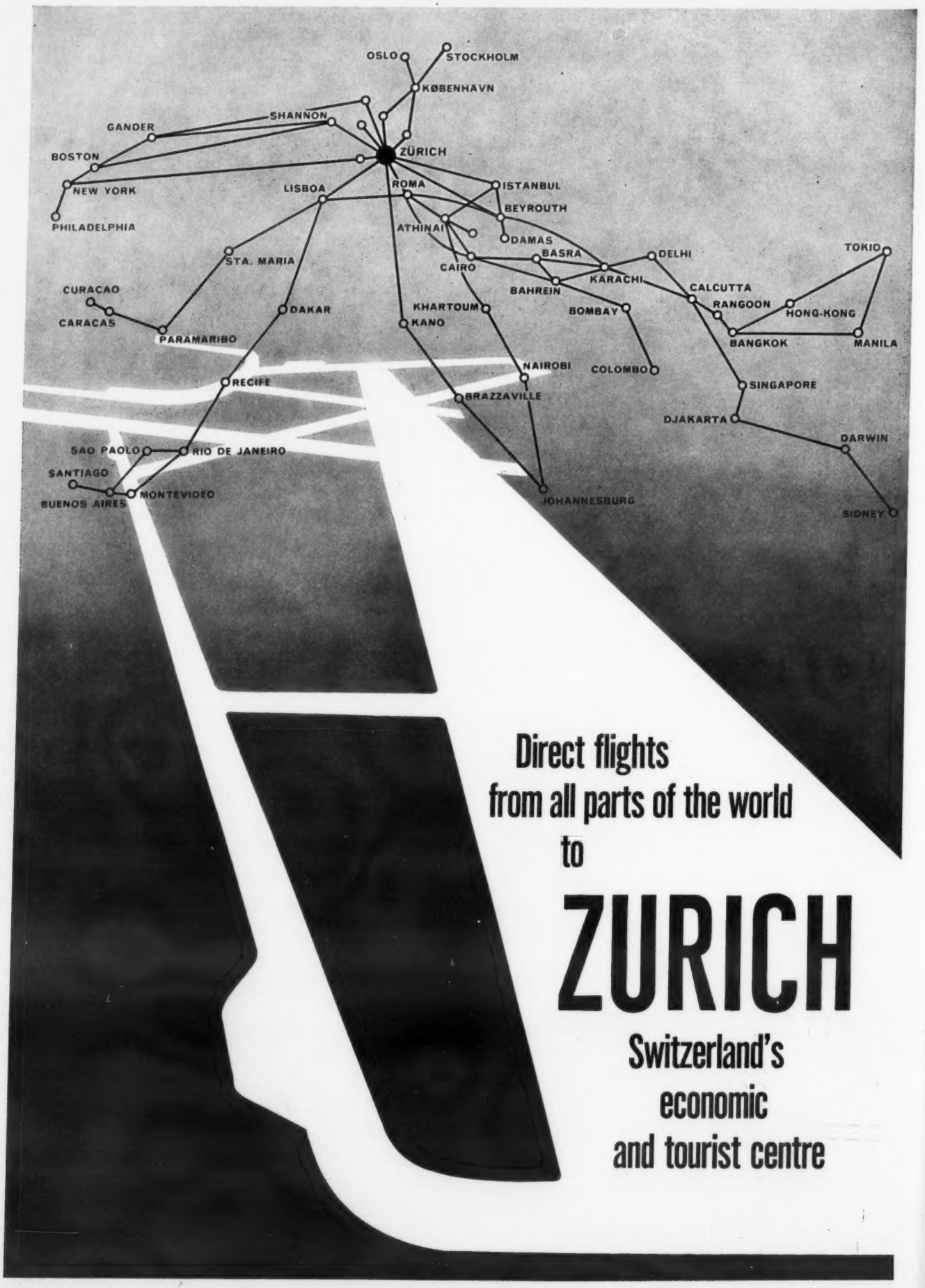

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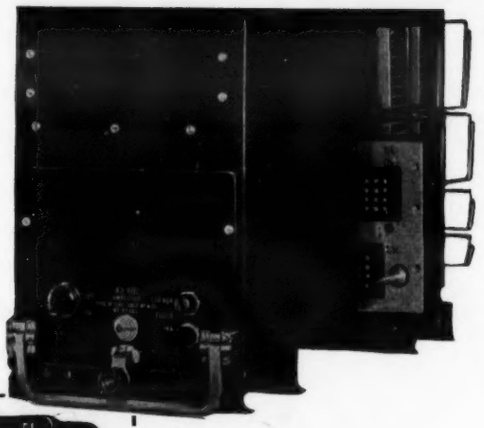

Above is the amplifier unit and the junction unit which serves as the backplate for the mounting rack of the amplifier unit, and thus eliminates cable connections between these two units. A main station box is shown on the left.

Features

- Self-contained power unit housed in amplifier unit.
- Detachable chassis arrangement and robust construction for ease in servicing.
- Lamp signalling between all station boxes.
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More than forty Airlines and twenty Air Forces fit Marconi air radio equipment. Marconi airport installations are in use throughout the world.

A minor station box is shown above. All units are designed to fit standard aircraft racking and for easy access in servicing.

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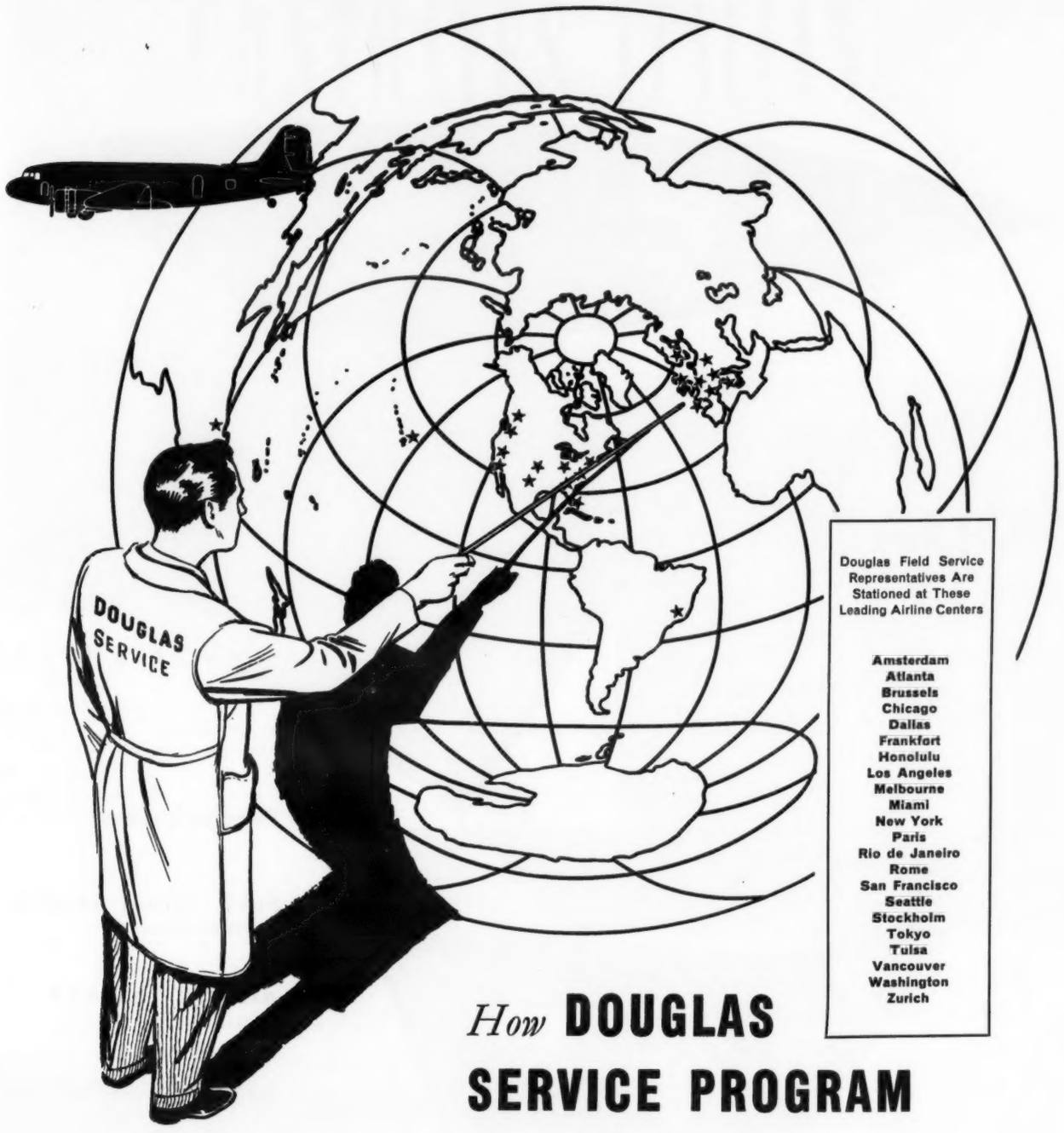

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Tulsa
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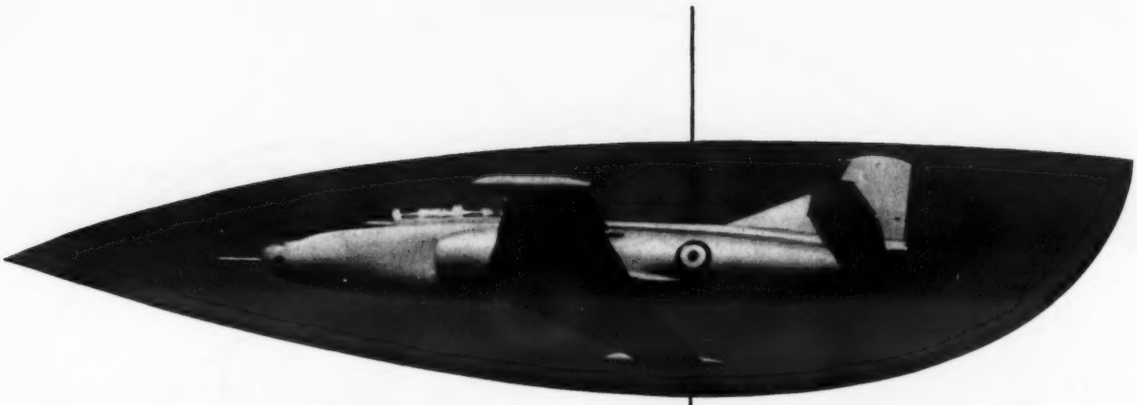

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Advanced and combat trainer

FIAT G 91
Engine: Bristol Orpheus
Light fighter for tactical support

FIAT F86 K
(North American Aviation licence)
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Turbojet engines:

FIAT «GHOST 48 MK 1»
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ALLISON J35-A29
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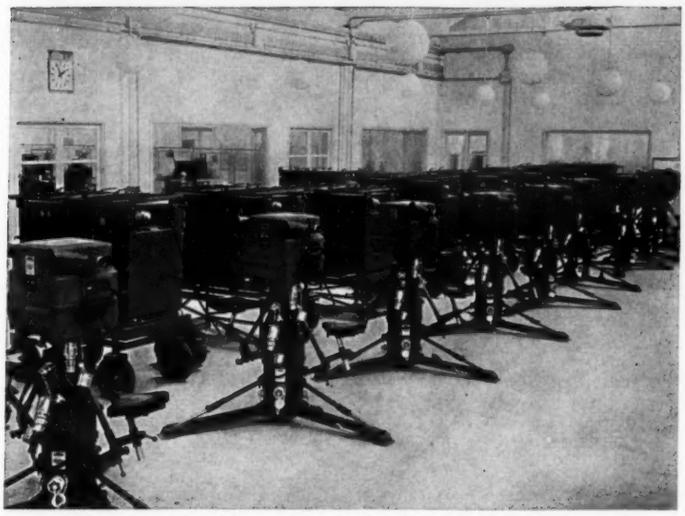

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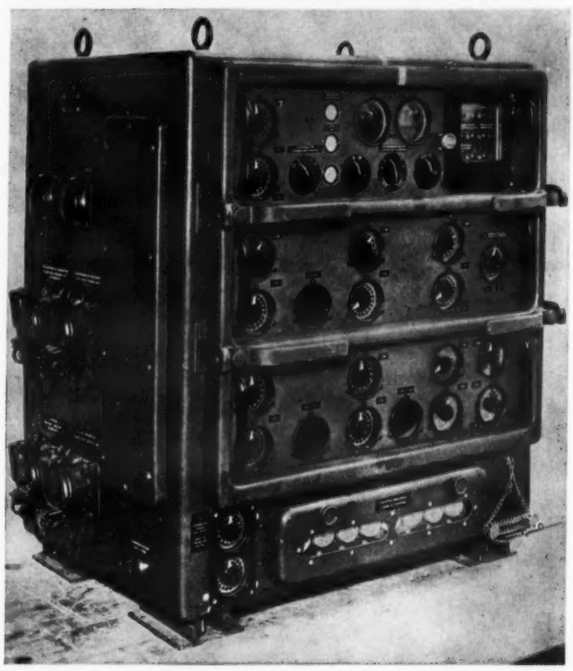
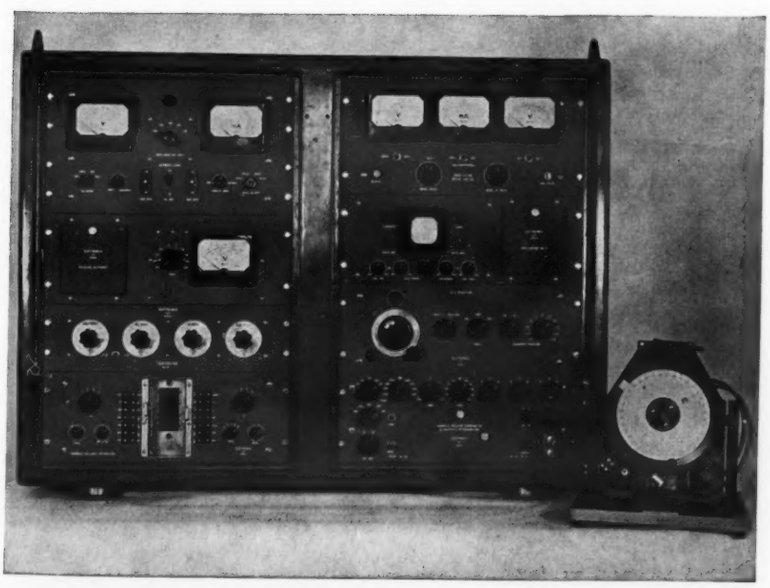


PARALLAX COMPUTER

between search and fire control radar



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Minimum Speed at Gross Weight	
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Flaps Down	48 MPH
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Useful Load	1610 lbs.
Gross Weight	3500 lbs.
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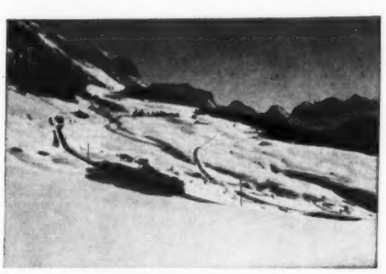
Can you imagine how happy these two people feel ? The " Suger cake " is the Matterhorn (Alpes valaisannes).



On the sunny side of good old Earth. This train will take you right into the heart of the Jungfrau (Bernese Oberland).

And here is the way to climb a mountain without getting tired. In front of the majestic Mont-Blanc, French Savoy.

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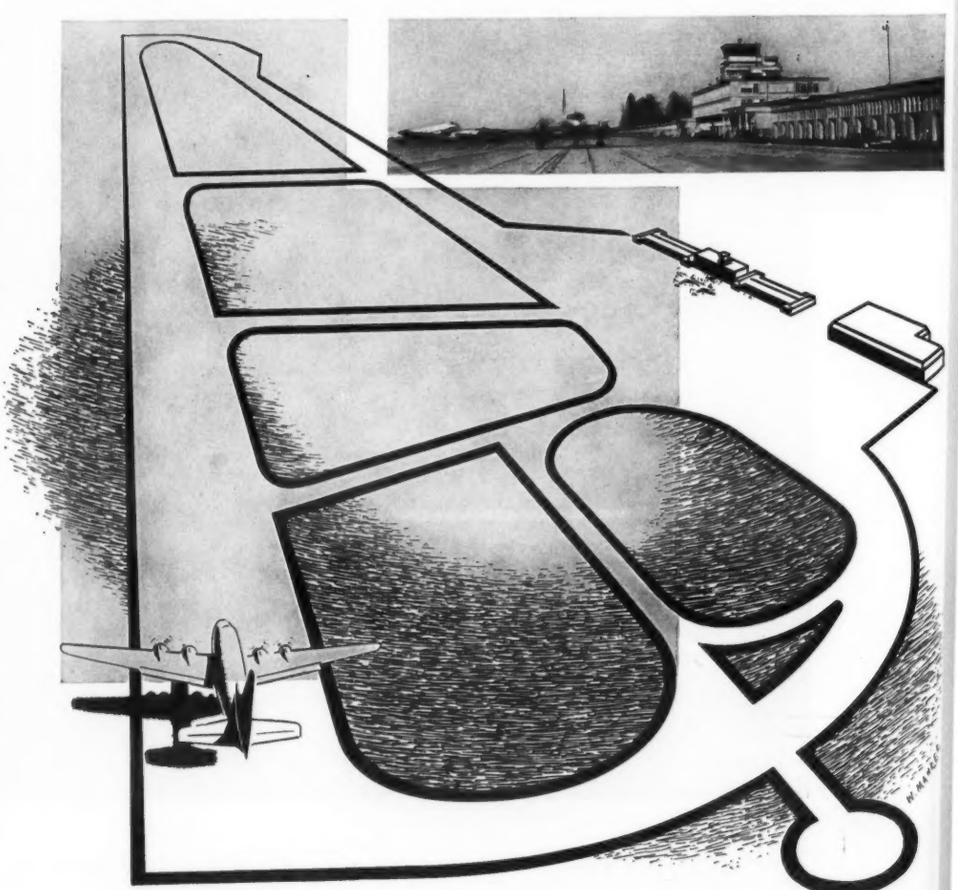

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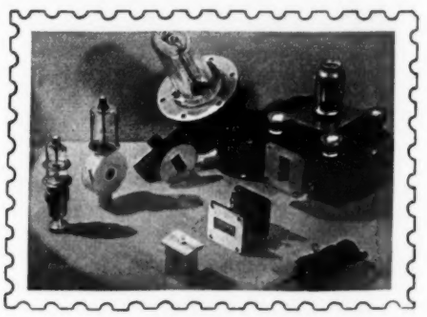
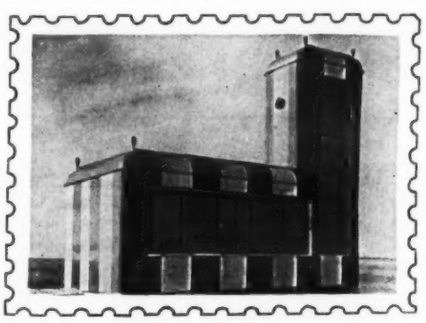


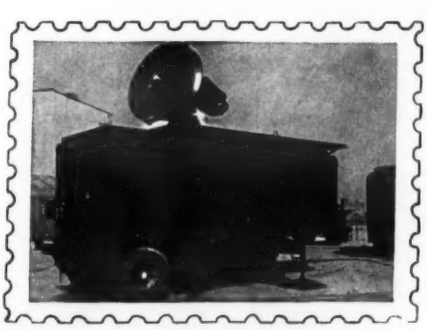
VHF TUBES

PORTABLE TRANSMITTER-RECEIVERS



G.C.A. EQUIPMENT

RADIO-COMMUNICATIONS



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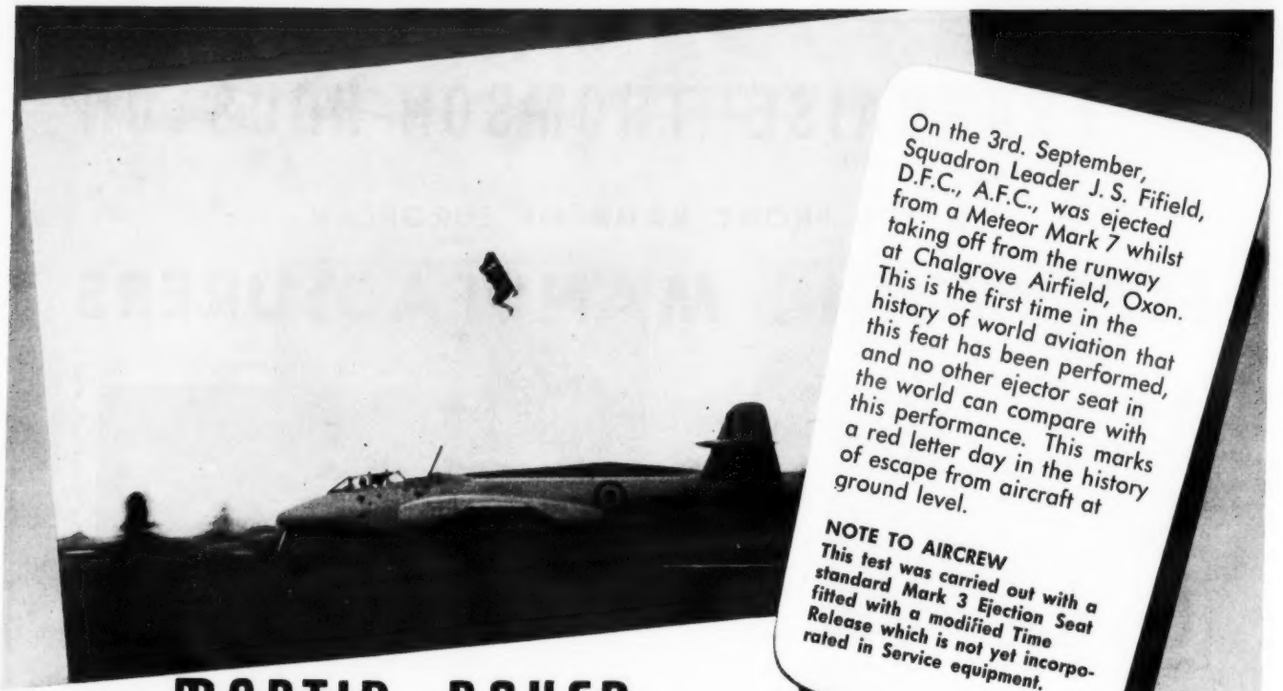

On the 3rd. September, Squadron Leader J. S. Fifield, D.F.C., A.F.C., was ejected from a Meteor Mark 7 whilst taking off from the runway at Chalgrove Airfield, Oxon. This is the first time in the history of world aviation that this feat has been performed, and no other ejector seat in the world can compare with this performance. This marks a red letter day in the history of escape from aircraft at ground level.

NOTE TO AIRCREW
This test was carried out with a standard Mark 3 Ejection Seat fitted with a modified Time Release which is not yet incorporated in Service equipment.

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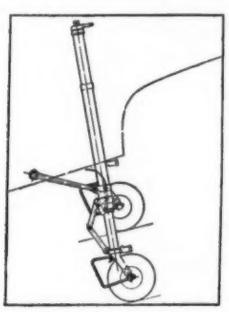
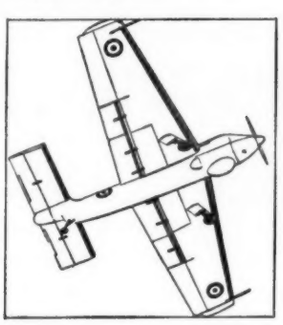
Coastal patrol — *Seamew* patrol

Because of its low landing speed, the Seamew can alight in an extremely small area. Tyre sizes can be easily changed to suit terrain.

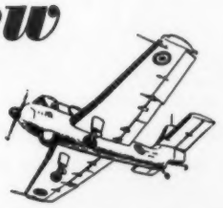


The two position tail wheel gives the advantages of a tricycle undercarriage layout for landing, while retaining the desirable features of the normal undercarriage for take-off.

Seamew—a tough, economical, all-weather submarine hunter. From an emergency coastal airstrip the Seamew can be airborne in a short distance to operate a wide-ranging patrol. It can conduct a maritime search with up-to-date radar equipment and use a variety of weapons to effect a kill. However rough-and-ready the airstrip, it can land back safely — with its low stalling and landing speeds and fixed, rugged, shock-absorbing undercarriage.



The *Short* answer is the *Seamew*



Generous flap surfaces contribute to the very low stalling and landing speeds. The Seamew is easy to fly and exceptionally manœuvrable.

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You naturally prefer reliable figures to preconceived ideas !

Here are some figures on the CARAVELLE

Some writers have expressed the fear that the mounting of the two jets in the rear of the " Caravelle " would on the one hand raise loading problems that would be difficult to solve and, on the other, give rise to instability phenomena.

In practice this fear has been proved to be groundless.

1. AERODYNAMIC QUALITIES.—

It is the thrust axis that must be considered, not the actual point of application of the thrust. In the " Caravelle " the position of the jets is such that it was a simple matter to make the thrust axes pass through the centre of gravity and thus to eliminate the influence of power on stability, whereas in the conventional aircraft the effect of the propeller slipstream is to reduce the qualities inherent in the airframe.

Flight tests have confirmed the results obtained in the wind tunnel:

1) permissible travel of the centre of gravity is 14% of the mean wing chord; the centre of gravity can travel between 25% and 39% of the M.A.C.; as this chord measures 14 ft. 9 ins., the aircraft's centre of gravity can travel 24 ins., or the centre of gravity of the normal payload (15,400 lbs.) can be shifted by 9 ft. 10 ins. in the aircraft;

2) with centre of gravity farthest back (39% M.A.C.) stability remains good; oscillations are rapidly damped out and have a sufficiently long period. Force required for a pull-out exceed 22 lbs. per 1 g;

3) with centre of gravity furthest forward (25% M.A.C.) the pilot has no difficulty in keeping the nose wheel raised well before take-off and well after touchdown;

4) finally, regardless of the centre of gravity position, changes in configuration (undercarriage, flaps, variations in power) have little effect on pilotage.

2. LOADING.—

All fuel is carried in the wings; variation in centre of gravity with tanks full or empty is less than 3% M.A.C.; variation with undercarriage retracted or lowered is 1% M.A.C.

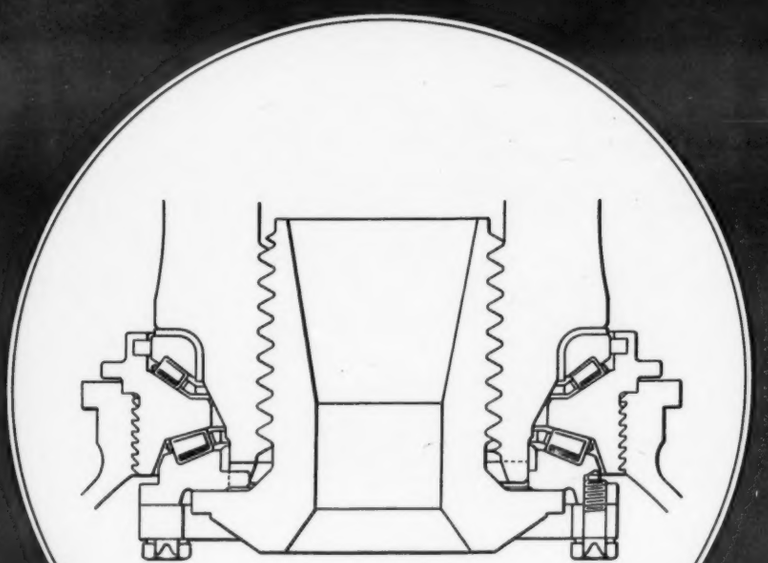
With the maximum payload evenly distributed, centre of gravity is at 28% M.A.C.; it can be moved forward if the heavier loads are placed in the forward part of the fuselage.

For lower payloads the capacity of the cabin and freight compartments is such that full advantage can be taken of centre of gravity tolerance when drawing up the usual loading chart.

Minimum payload required to ensure a normal centre of gravity is only 1,760 lbs.

CONCLUSION.—

The " Caravelle's " centre of gravity tolerance is such that it imposes no limitations on operation. This essential quality is due in particular to the position of the jets.



Blade-root mounting of the Rotol propeller

In the blade mountings of Rotol variable pitch propellers—such as those on the Vickers Viscount and many other famous aircraft; on the rotor shafts of helicopters—carrying the whole weight of the machine—and in other vital situations, there you will find Timken tapered-roller bearings. They are made in an extensive range of sizes, including lightweight thrust bearings—single and double. Furthermore, the bearings in the range, originally evolved for road vehicles, in themselves have a very high load-to-bearing weight ratio, which makes them ideal for many aircraft applications.

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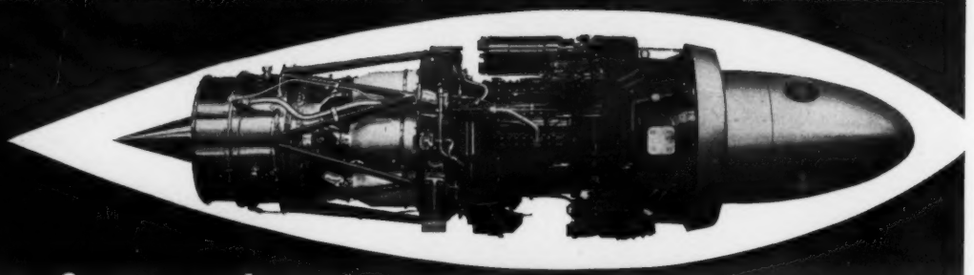
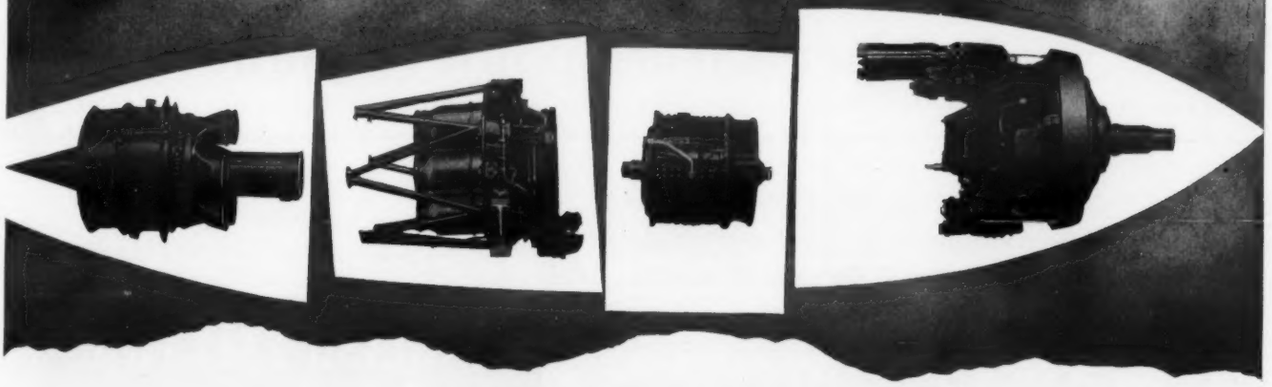


power in four packages

One big advantage of the Napier Eland propeller-turbine is easy maintenance. Eland power comes in four packages — (1) the reduction gear assembly, (2) the compressor assembly, (3) the main support plate and combustion chamber assembly and (4) the turbine unit. Interchangeability of these major components is catered for, thereby ensuring simple and cheap maintenance.

more facts about the Eland

- *High aerodynamic efficiency — 3,000 e.h.p. in a maximum diameter of 36 inches.*
- *Low specific weight — 0.52 lbs./e.h.p.*
- *Low specific fuel consumption — 0.450 lbs./e.h.p./hr. at 36,000 ft. 400 knots cruising: 0.505 lbs./e.h.p./hr. at 20,000 ft. 350 knots cruising.*
- *Ease of control — single lever control with manual over-ride, guards against engine overspeeding and overfuelling.*
- *Automatic temperature compensation.*
- *At the first attempt the Eland has recently passed a 150 hour type test rehearsal at the full 3,000 e.h.p. rating.*



NAPIER Eland turbo-prop

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The only aircraft ever to hold, at the same time, world records for height and for speed from point to point

* The ENGLISH ELECTRIC Canberra (powered by two Bristol Olympus engines) holds the world's height record for aircraft at 63,688 ft. (19.406 metres).

* The ENGLISH ELECTRIC Canberra (powered by two Rolls-Royce Avon engines) holds 12 world speed records, including London to Christchurch (New Zealand) at an all-in speed of 494.5 m.p.h. (795 k.p.h.).

'ENGLISH ELECTRIC' Canberra

THE ENGLISH ELECTRIC COMPANY LIMITED, QUEENS HOUSE KINGSWAY, LONDON, W.C.2

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INTERAVIA

Deadline Notes

No. 11/1955

BRITISH CHIEFS OF STAFF COMMITTEE TO HAVE INDEPENDENT CHAIRMAN

The long-expected reorganization of Britain's defence system has now been undertaken. Prime Minister Sir Anthony Eden has announced that the Chiefs of Staff Committee is in future to have an independent Chairman. First to hold the new post will be Marshal of the Royal Air Force Sir William Dickson, hitherto Chief of the Air Staff. Sir William's duties will also include representation of the United Kingdom on the Military Committee of the North Atlantic Treaty Organization. The powers of the Minister of Defence are also to be strengthened, and he will be granted coordinating authority over planning and training in the civil and military spheres.

BELGIUM ALSO PLANNING PASSENGER CHARGE

The Belgian civil aviation estimates for 1956 reveal that Belgium is planning to introduce a departure charge for passengers and freight at all airports.

RUSSIA AND FINLAND SIGN AIR TRANSPORT AGREEMENT

Finland is the first non-Communist country to have concluded an air transport agreement with the Soviet Union. The agreement enables the Finnish airline Aero O/Y to operate services between Helsinki and Moscow.

U.S. AIR FORCE AUTHORIZED TO PROCEED WITH AIRCRAFT WARNING SYSTEM

Comptroller General Joseph Campbell has informed Defense Secretary Charles E. Wilson that he has authorized the U.S. Air Force to go ahead on the S.A.G.E. (Semi-Automatic Ground Environment) aircraft warning system without awaiting advance Congressional approval. However, the project must be submitted to Congress as soon as possible . - S.A.G.E. is a ten-year plan covering a 25,000-mile telephone network to alert all radar centres in the United States in the event of an air attack. Total cost of the project is estimated as $2,400,000,000.

ATOMIC PROVING GROUND IN THE AUSTRALIAN DESERT

The Maralinga rocket range in South Australia is to be turned into the British Commonwealth's permanent atomic testing centre. The site will have an 8,000-ft. runway suitable for the world's largest bombers. The Bristol Aeroplane Company will supply prefabricated houses for scientists and other staff.

UNITED AIR LINES ORDERS DC-8s

Pan American World Airways' contract for 25 Douglas DC-8 jet transports (see under "What's in the Air?" in the present issue) has now been followed by an order from United Air Lines for 30 aircraft of this type at a total cost of roughly $175,000,000. Deliveries are to begin in May 1959, and U.A.L. hopes to have the type in service by the end of 1959.

NEW YORK AIRWAYS ORDERS SEVEN SIKORSKY S-58s

New York Airways, which operates helicopter services between the New York airports and the city centre, has ordered seven Sikorsky S-58 helicopters (for 12 passengers), for service in June 1956. At present the company operates five Sikorsky S-55s (eight to ten passengers). The new aircraft will cut mileage costs by roughly 50%, and cruising speed will be raised from 85 m.p.h. to 105 m.p.h., Company President Robert L. Cummings announced.

IDLEWILD EXPANSION

Work on the $60,000,000 project for the expansion of New York International Airport at Idlewild will begin early in November. The first building to be erected will be the international arrival block, with two adjacent wings for foreign flag airlines.

* From INTERAVIA's world-wide news service, including INTERAVIA AIR LETTER, the daily international aviation news digest. — No part may be reproduced without written permission.

REDUCED AIR FARES FOR INTOURIST PASSENGERS

The Soviet Union is offering foreign tourists a 50% reduction in rail and air travel, V. Ankudinov, President of the Russian travel organization Intourist told the annual convention of the British Travel Agents Association in Folkestone. The first 620 miles by train will be free.

U.S. INDUSTRY MUST FINANCE RESEARCH

Speaking at a convention of leading United States insurance executives, Lockheed Aircraft Corporation President Robert E. Gross said that the United States Government is adopting a new attitude towards the aircraft industry, forcing it to stand on its own feet. Thus the industry must in future invest more heavily in its own high-speed wind tunnels, laboratories, nuclear reactors, new test devices and modernized manufacturing facilities. Lockheed is preparing to spend "at least $ 25,000,000" on such projects, he revealed.

ZURICH INSTITUTE OF TECHNOLOGY HONOURS VON KARMAN

The Swiss Federal Institute of Technology, Zurich, has awarded honorary degrees to 22 scientists from all over the world, to mark its centenary. The only award for aeronautical research has gone to Professor Theodore von Karman, Professor at the California Institute of Technology and Chairman of N.A.T.O.'s Advisory Group for Aeronautical Research and Development. The honorary degree has been granted "in recognition of his outstanding scientific achievements in the field of technical mechanics, in particular aeronautics . . . and his contribution to international technical and scientific cooperation."

CANADA AND ISRAEL ORDER BRITANNIAS

The Bristol Aeroplane Company has received an order from Canadian Pacific Airlines for three Britannia 300 LR turboprop long-range transports (100 passengers), with delivery to begin in 1957. C.P.A. has also taken an option on a further five aircraft of the same type, while El Al Israel Airlines is reported to have ordered three Britannias for 88 passengers.

BELGIAN AIR FORCE ESTIMATES

Under the provisional estimates for the 1956 budget, the Belgian Air Force is to receive credits amounting to 3,157,822,000 francs of the ordinary budget. In 1954, the Air Force received 2,720,000,000 francs under the ordinary budget and 637,000,000 francs in supplementary appropriations; the corresponding figures for 1955 are 3,380,000,000 francs and 935,000,000 francs respectively. Credits under the supplementary estimates for 1956 are not yet known.

WORKSHOP BRIEFS . . .

Lockheed Aircraft Corporation announces that the wing area of the Electra four-turboprop transport has been increased from 1,200 sq.ft. to 1,300 sq.ft. Main dimensions are increased accordingly, and max. gross weight has been raised from 99,500 lbs. to 110,000 lbs. Performance is only slightly affected, but range is considerably increased. * A wind tunnel model of the Saab-35 (J-35) supersonic fighter shown in public for the first time reveals that the wing unit is of the double delta design which has been tested in the experimental Saab-210 Draken. The J-35 has a single jet engine and is designed for max. speeds corresponding to Mach 1.5. First flight on October 25th, 1955. * Bureau Technique Zborowski is working on a coleopter target aircraft for high speed and high altitude. Power plant, one Rolls-Royce Soar. * Both the Douglas DC-8 and the Boeing 707 are fitted with silencers for the engines and thrust reversal devices to brake the landing. * A Boeing B-47 bomber withdrawn from squadron service will probably be loaned to Orenda Engines Ltd., of Malton, Ontario, for flight testing the latter's P.S.13 high-power turbojet. * The first atomic-powered aircraft of U.S. design is expected to be ready for testing by 1958-59. - According to East German sources, a Russian atomic-powered aircraft should begin tests "shortly". * The first of two VTO fighter prototypes built by Ryan Aeronautical Co., has begun flight testing. * The Dart RDa.7, latest version of the Rolls-Royce turboprop, delivers 2,105 e.h.p. for take-off at sea level. Engines of this type are to be fitted in the Viscount Major ordered by B.E.A.

* * *

From Radlett to Farnborough

Ten Years Preparation for Twenty Years of Flying

BY INTERAVIA STUDY GROUP

Ten consecutive annual Displays since the end of World War II have borne witness to the scope of the British effort in the field of aeronautical research and production.

At the last Farnborough Display the uninitiated might have imagined signs of flagging in the race for aeronautical supremacy which Britain has persisted in running against more powerful rivals. Two years ago—particularly after the *Comet* affair—criticism was almost as widespread and as unreasoned as praise had been previously. The nature of public opinion is such that it passes from one extreme to the other, hastily formulating generalizations which facts are quick to disprove.

The 1955 Display could not show the world a new generation of military and commercial aircraft because 1949 was the "great year" for civil equipment, and 1952 the "great year" for military models. The technical cycle today covers at least eight or ten years for the former and six or seven years for the latter. However, the equipment shown at Farnborough this year is rich in promise and includes a new generation of power plants to succeed the British engines designed at the end of World War II, which, it is not exaggerated to say, dictated the shape of aviation today. Commenting on the last few days of the Display, Mr. J. J. Parkes, President of the Society of British Aircraft Constructors, said that standholders had never been more satisfied... He did not think that the Show should be judged by the number of prototypes seen: "We should always keep in mind that it is a business meeting and the best judges of it are the people who pay to come here, the businessmen from the other side of the world..." He added that Britain was only at the beginning of a growing export of both commercial and military aircraft and that this was the last moment to talk of abandoning Farnborough as an annual event.

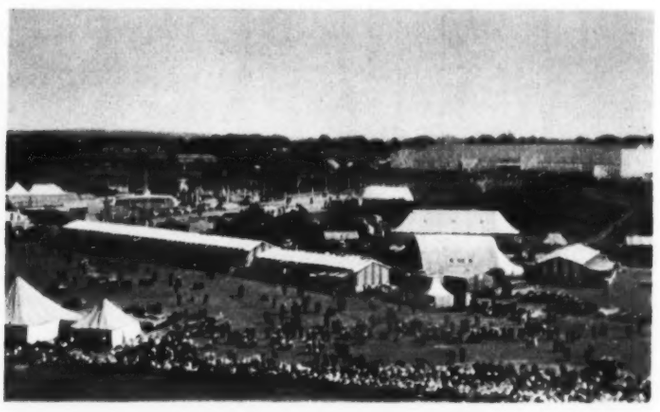
Prime Minister Sir Anthony Eden leaving Farnborough in an Avro *Vulcan*... "No rolls this time, please" he requested the pilot.

J. J. Parkes, President of the Society of British Aircraft Constructors and Chairman and Managing Director of Alvis Ltd.

There is nothing surprising in Mr. Parkes' remarks. Farnborough is indeed a "business meeting." To understand its importance and its aims, it is necessary to grasp the peculiar conditions essential to the existence and prosperity of the British Isles. With her restricted natural resources Britain is obliged to import in order to live and hence to export to balance her purchases from abroad. As long as industrialization was limited to a few countries there was a wide range of raw materials and manufactured goods that Britain could readily sell abroad. But the development of world industry and its extension to a constantly growing number of nations have had a dual effect: the range of saleable goods has narrowed and become restricted to articles requiring a higher and higher degree of technical progress. Britain is obliged constantly to raise the technical standard of her export goods so as to be able to offer the rest of the world what it cannot produce itself. There are still very few countries with an aircraft industry of their own, and demand continues to grow as air transport expands. Thus there is still a sub-

Radlett 1946 . . . aircraft of the transition period: front row: *Swallow, Vampire, Hornet, Mosquito, Dove, Meteor,* etc.; behind, *Wayfarer, Nene-Lancastrian, Hastings, Tudor,* and *Lincoln.*

Farnborough 1955 . . . matured designs: 61 aircraft types, 307 exhibitors, 300,000 visitors. The large exhibition tent (in background) is to make way for a permanent building.



stantial market open to the few producer countries. Britain, traditionally and necessarily an exporter, must inevitably figure in the front ranks of these countries. The imperative need for constant effort in the aircraft field is therefore obvious. It is equally clear that it must be directed rather at meeting the needs of the world market than to satisfying strictly national requirements, either civil or military. When this factor is remembered, the disparate quality of the flying equipment presented at each Display, the reappearance year after year of out-dated aircraft, the apparent dispersion of technical and financial effort are readily explained. The most advanced models may meet British or Allied needs in Europe and illustrate the quality of British research and production. Others should be seen through the eyes of overseas purchasers whose strategic and commercial requirements are less stringent or whose operating conditions are more limited.

In Britain itself not all military spokesmen have been lenient with the defence and combat equipment available today to the Royal Air Force and the Fleet Air Arm. Their criticisms should be examined in the light of the new conditions of any future conflict in which the United Kingdom were directly involved. The inadequacy of even the best conventional air defence organization and the limited part which Fighter Command could play in such a war, the scale of destruction that could be produced by a very small number of atom-bomb carrying aircraft, all overturn many fixed ideas and doctrines confirmed by R.A.F. successes during World War II. It is natural that, remembering the size of Bomber Command in those days, the "old hands" should become indignant about the small number of squadrons already equipped or to be equipped with *Valiants, Vulcans* or *Victors*. But they should not forget that each of the R.A.F.'s four-engined bombers can carry—at a speed approaching that of sound—a destructive potential ten to fifty thousand times as great as the 20,000-lb. "Grand Slam" which Air Marshal Harris's *Lancasters* transported at 250 m.p.h.

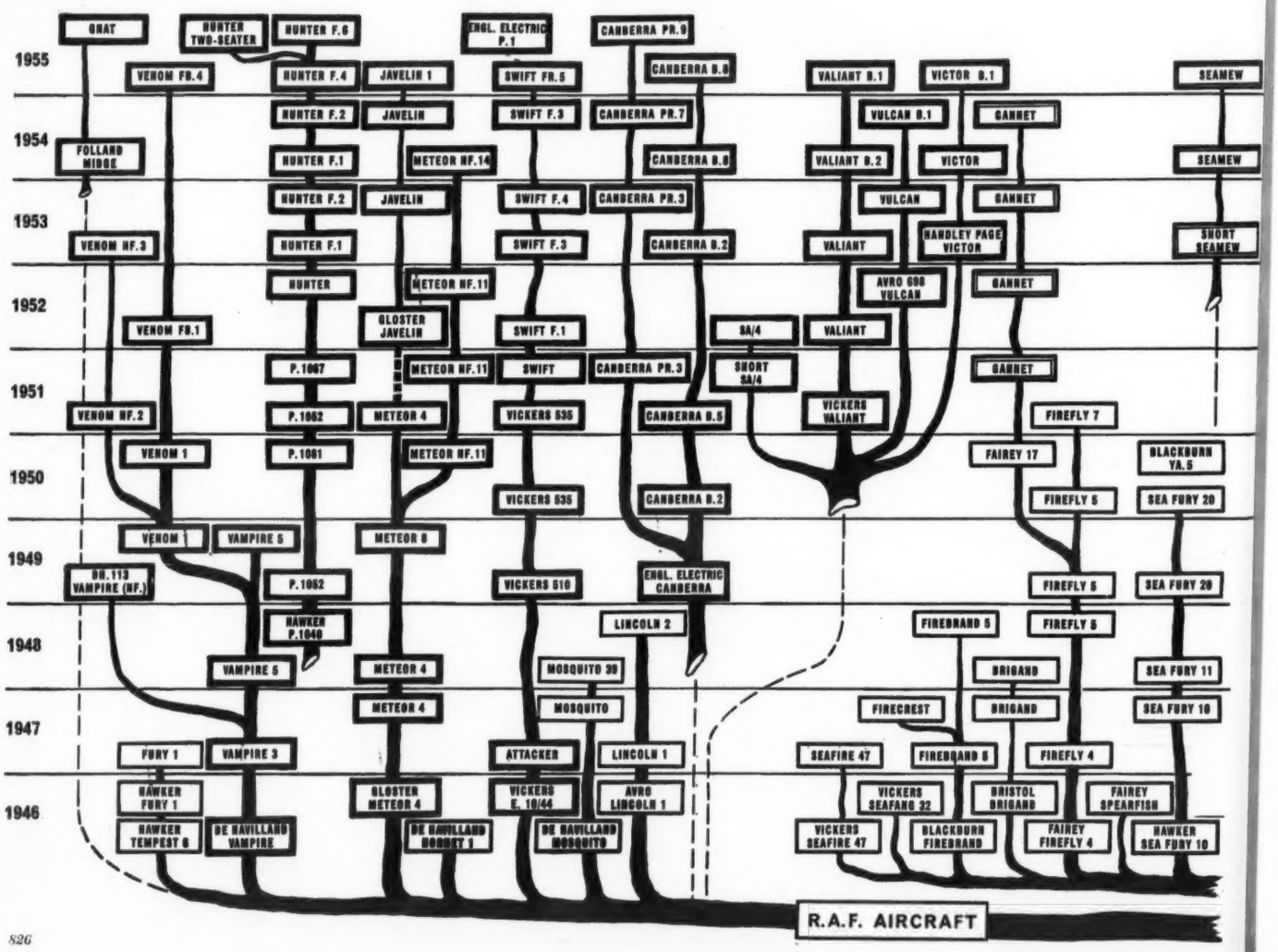
1955: R.A.F. formations over Farnborough for the first time in war strength: one of the four teams of sixteen Hawker *Hunter* interceptors.

1955: the new English Electric P. 1 supersonic fighter.

*

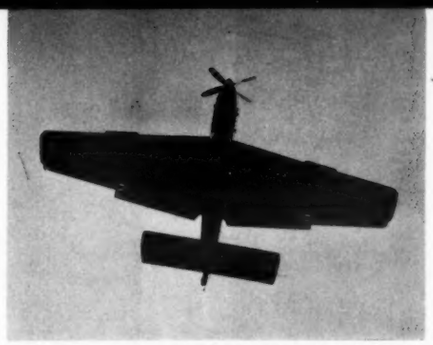
TABLE I: "Genealogical Tree" showing Britain's major *combat aircraft and military trainers*, as seen at the last ten S.B.A.C. Displays. They are grouped into the following main "branches": 1 — R.A.F. aircraft; 2 — Fleet Air Arm; 3 — trainers and artillery observation aircraft.

Diagram illustrating the British habit of deriving new prototypes from older similar types and building several variants of the same basic type for flight testing.



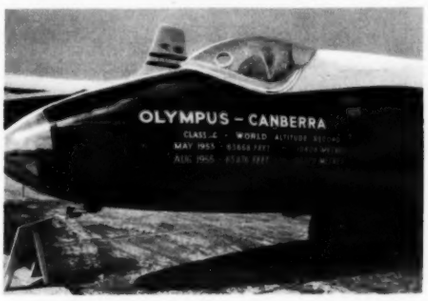
Time was on their side

A detailed study of the past ten years' work can best be made by analysing the various designs presented at Radlett and Farnborough from 1946 to 1955. "Shop windows" of British aeronautical engineering, the Displays illustrate the general policy followed, reveal the directions in which engineers are working and confirm their success or their past failures. In addition, they indicate the future of this branch of engineering whose rate of development has been slowed down by the growing complexity of the problems to be solved. The first Avro 707, shown to the public in 1949, was a forerunner of the *Vulcan,* just as the D.H. 108 of 1946 and the *Ghost Lancastrian* of 1947 prepared the way for the four-jet commercial transport offered for sale five years later. This September the experimental aircraft which served as flying test beds for the Rolls-Royce *Conway* and the de Havilland *Gyron* demonstrated the engines that will power high-performance civil types and supersonic military aircraft six years or more from now.



1955: Short *Seamew* anti-submarine aircraft, latest addition to the Fleet Air Arm's varied fleet.

1955: a new international altitude record has been set up by the Bristol/English Electric *Olympus Canberra.*



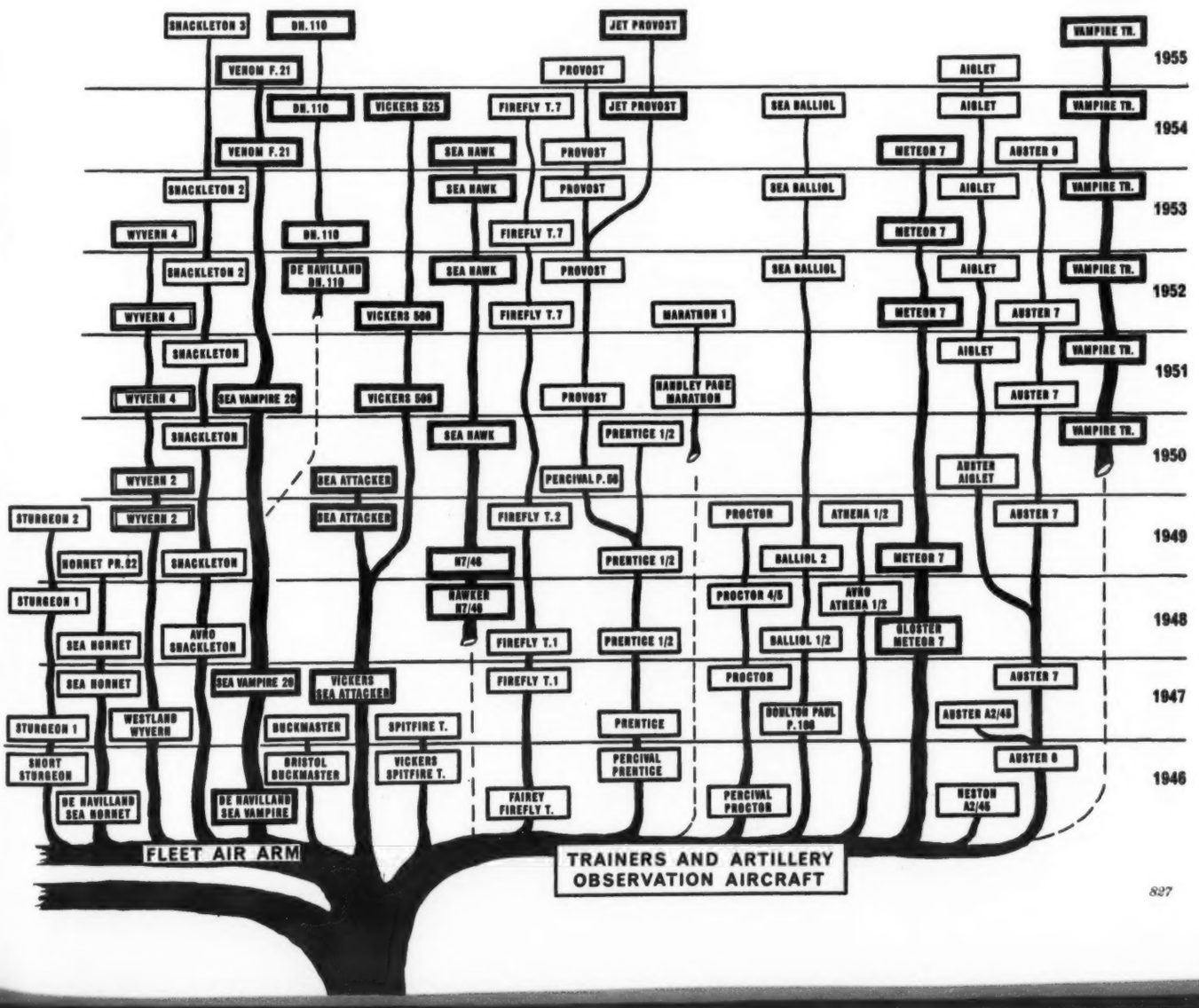
The development policy revealed to the world year by year is illustrated in diagrammatic form in the accompanying tables, which show the main aircraft in all categories demonstrated in the Static park or in flight at Radlett and Farnborough.

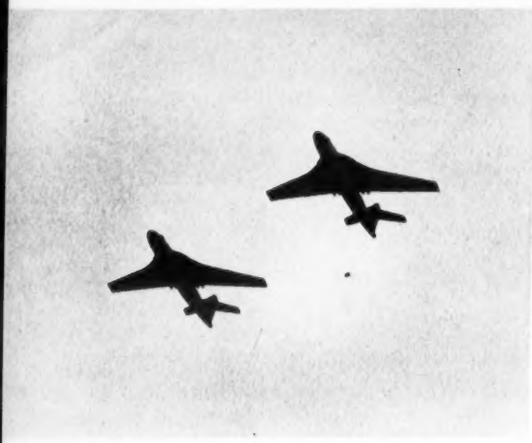
In the service aviation field table I reveals the following:

• 1. It took three years to get rid of the heritage of the war and eliminate piston-engine combat types. But it was obvious at that time that, though out of date in Europe, most of these types still retained military value in other theatres. The Displays of 1946 to 1949 enabled other countries to acquire at bargain rates equipment that Britain could no longer use herself. In 1947, for example, somewhere approaching thirty military types were shown on the ground or in the air; of these only four were jet-powered, and less than ten have since been adopted by the Royal Air Force or the Fleet Air Arm.

• 2. Britain's naval problem has strongly influenced her technical policies and hence

Piston-engine aircraft. Turboprop aircraft. Turbojet aircraft.





Vickers *Valiant*, first representative of the V-bomber family has been in production for some time . . .

TABLE II: S.B.A.C. DISPLAYS FROM 1920-1955

No.	Year	Place	Duration (days)	Visitors (number)	Exhibitors (number)	Aircraft (number)
*	1920	Olympia, London	1	Public	—	—
*	1929	Olympia, London	1	Public	—	—
1	1932	Hendon	1	Guests	21	34
2	1933	Hendon	1	Guests	38	45
3	1934	Hendon	1	Guests	47	41
4	1935	Hendon	1	Guests	65	26
5	1936	Hatfield	1	Guests	95	36
6	1937	Hatfield	1	Guests	94	38
7	1946	Radlett	1	7,000 G.	115	51
8	1947	Radlett	1	14,000 G.	156	64
9	1948	Farnborough	4+3	14,000 G. 100,000 P.	163	65
10	1949	Farnborough	4+3	15,000 G. 95,000 P.	167	54
11	1950	Farnborough	4+3	33,000 G. 120,000 P.	170	61
12	1951	Farnborough	4+3	28,000 G. 200,000 P.	177	51
13	1952	Farnborough	4+3	38,000 G. 300,000 P.	196	56
14	1953	Farnborough	4+3	44,000 G. 310,000 P.	227	54
15	1954	Farnborough	4+3	48 000 G. 308,000 P.	292	65
16	1955	Farnborough	4+3	60,000 G. 240,000 P.	307	61

* Exhibition Nos. 1—16: Flying Displays and Exhibitions

contributed in a large measure to the nature of the Radlett and Farnborough Displays. In 1946 there were no fewer than a dozen aircraft types capable of carrying out naval missions. Just as in the economic field the country's physical conditions necessitate a sustained export effort, so the island situation imposes special conditions on aircraft programmes. The naval influence has not only widened the scope of engineering development and encouraged the design of special types for air-sea combat, but has also led to a certain technical conservatism. The latter comes to light in both the aerodynamic forms and the power plant used in the aircraft shown. All navies, with the possible exception of the U.S. Navy, have been more interested in function than in pure performance. The conditions under which naval flying equipment has to operate are so restricting that designers are obliged to adopt compromise solutions that are generally unfavourable to very high performance. The carrier-borne fighter has always been heavier than its land-based counterpart. In the case of the sea reconnaissance aircraft, which operates against relatively slow-moving targets, but is required to carry out missions of long duration, speed is not an essential requirement. Table I shows the place which piston-engine naval equipment held for many years among the range of aircraft offered the world from 1946 to 1955. Recently the turboprop, providing the best compromise between endurance and speed, has begun to make headway in this field, with the Westland *Wyvern,* Fairey *Gannet* and finally the Short *Seamew*. But from 1946 to 1951 the piston engine held undisputed sway.

• 3. Political, economic and strategic conditions have retarded the modernization of the R.A.F. After the end of the war in the Pacific a long period of peace seemed assured. Yet Hiroshima, whose military consequences were still difficult to assess, had already set the general problem of the new forms a future war would take. Strong in the progress made during the war and supplied with ample numbers of *Vampires* and *Meteors* designed before the victory in Europe, the British service authorities felt they had a breathing space in which to prepare, calmly and carefully, a new technical step forward. It was not until 1949 that the English Electric *Canberra* and the Hawker P.1052, ancestor of the *Hunter,* appeared. And it was not until 1951 and 1952 that the prototypes of the equipment designed to replace Bomber Command's *Lincolns* and *Washingtons* (B-29 *Superfortresses*) were first shown. Admittedly British engineers, faithful to the principle of evolution, had meanwhile derived the *Venom* from the *Vampire* and the NF 11 family from the *Meteor*.

. . . closely followed by the Avro *Vulcan*, whose enormous radar nose is unusually photogenic.

The execution of a technical policy has become such a long and complex affair that the effects of this brand of inertia which marked the early post-war military programmes are still apparent today. The Radlett and Farnborough Shows of these past ten years are perfect illustrations of this phenomenon.

• 4. The Displays also reveal another aspect of the aeronautical policy followed in Britain: the use of the same basic types by different services. Despite its fundamental specialization, the Royal Navy has quite frequently accepted the principle of "navalizing" R.A.F. equipment. Similarly, *Vampires, Meteors, Varsities* and *Canberras* have been found in the R.A.F.'s combat units as well as in trainer versions at the schools.

• 5. The most striking feature emerging from an examination of table I, however, is the continuity of the effort towards adaptation and improvement of aircraft types. For example, the Avro *Shackleton* has been shown regularly to naval guests at Farnborough from 1948 to 1955. Each year the four-engine type has been improved in performance and equipment, and the original design has been "stretched" by secondary modifications. The English Electric *Canberra,* with its successive versions, is another case in point. An even more striking example of the policy of gradual evolution followed by British designers is the family of Hawker single-jet fighters. The production *Sea Hawks* and *Hunters* were arrived at via the 1040, 1052, 1080, 1070, 1067 etc., each of which was presented in turn at Farnborough, marking the individual stages on the road to the combat model. Even when the latter has been selected, other variants continue to appear as progress

1955: Latest version of the Avro *Shackleton* (nose-wheel undercarriage) in high-speed flight with bomb bay open.

1950: For purposes of comparison an older version of the same aircraft still with tail-wheel undercarriage.

is made in power plant or armament. The Vickers-Supermarine *Swift* has an equally long ancestry. The question that arises is not whether such a policy is fruitful, but whether it has not been pushed too far in the case of the *Hunter*. In the race against time it may sometimes be necessary to skip some of the intermediate or over-specialized versions.

• 6. At first glance the accompanying tables might be taken to support the accusations of the dispersion of effort and funds that have so frequently been made against the Air Ministry and the Ministry of Supply in recent months. Why three aircraft to similar strategic bomber specifications? Why so many different models for Coastal Command and the Fleet Air Arm? When it is remembered that the destructive potential of a single atomic bomb is such that the number of aircraft required to obtain a given scale of destruction can be greatly reduced, it will be recognised that a modern Bomber Command should be more concerned with acquiring aircraft with very high performance than with building up a vast number of squadrons. A compromise must be found between financial potential as regards quantity and operational efficiency as regards quality. Within the limits of the funds available, it is obvious that it has been decided to seek quality at the cost of having to make do with smaller numbers. Three different designs had been submitted, whose qualities could be judged only by practical experience. Hence the family of three V-bomber prototypes.

The variety of naval types is due to the variety of tasks undertaken by the Royal Navy, ranging from long-range reconnaissance to coastal patrol, via defence missions and attack on submarines and surface targets. In the field of air defence, where the technical and sentimental heritage left by Fighter Command from the Battle of Britain days is the most powerful, the number of designs is more limited, with originally two rival day fighters (*Hunter* and *Swift;* the latter, however, has since been relegated to ground attack duties) followed more recently by the English Electric P.1 prototype, and two all-weather interceptors (Gloster *Javelin* and de Havilland D.H. 110; the latter has been dropped by the R.A.F. but is being developed for the Navy). The only surprising feature is that Britain should not, as have the United States (Lockheed F-104, a "relatively light" interceptor), Russia (several rocket fighter types) and France (SO.9050 and MD 550), have ventured further along the dual road of light aircraft (the sole example so far is the Folland *Gnat*) and (at least until recently) of mixed propulsion models designed to combine bursts of very high speed at all levels with improved endurance. However, recent reports state that two projects for interceptors with mixed propulsion are in an advanced stage of development at Saunders-Roe and A.V. Roe.

*

Storming the civil market

The subjects of civil and military transport aircraft must be dealt with simultaneously since Britain has been wise enough not to develop specialized types but to design military versions of all suitable commercial aircraft. Some of the remarks already made on other categories also apply to the transport field. Here, too, there was the same multiplicity of designs in the years immediately following the war. Here, too, there has been the same insistence on offering equipment capable of resisting technical aging; the D.H. *Dove,* for example, has been shown ever since 1946, and the Scottish Aviation *Pioneer* has been a faithful participant in all the Displays, seeking the market that it was refused as an artillery observation post in 1945. But besides these characteristics that are common to both military and civil types, other factors are brought to light by table IV:

• 1. A first reaction on studying this table might be doubt of the virtue of long-term programmes prepared by a group of experts in the seclusion of ministerial offices and within a planning framework that is too abstract to be in touch with practical engineering progress or with the commercial development of civil aviation. Very little remains of the Brabazon Committee's original recommendations. Whenever programmes have been too daring as regards size and weight, or whenever designers have jumped too far ahead of general world developments, particularly in power plants, the results have been spotty, to say the least. The Bristol *Brabazon 1* and Saro *Princess* in the former category, and the D.H. *Comet* in the latter will serve to illustrate this point.

Handley Page *Victor*, last of the three V-bombers, approaching to land. – Behind, the Saro *Skeeter* (left) and Bristol 173 helicopters.

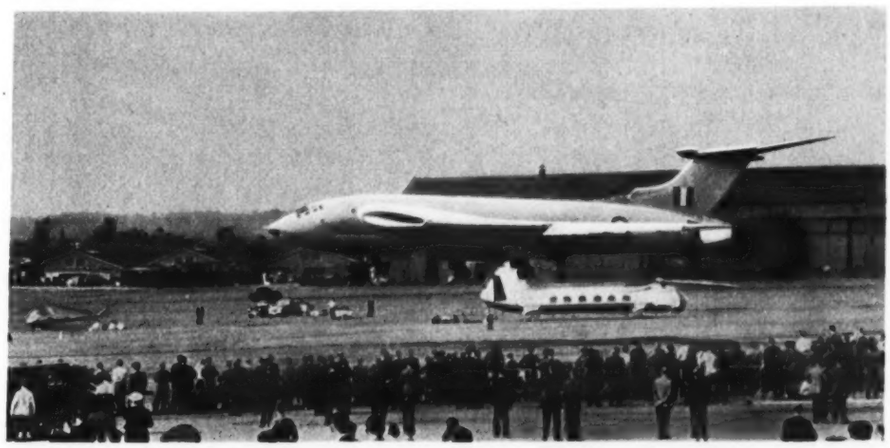
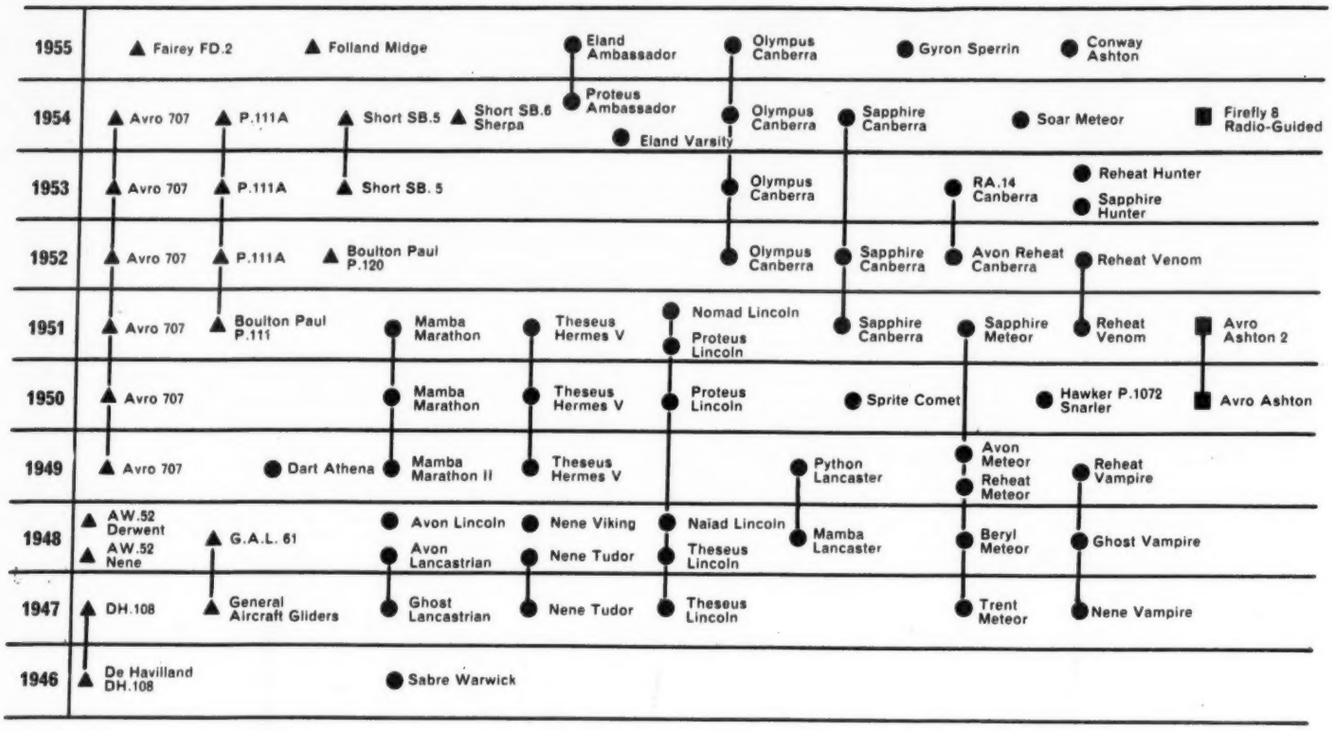


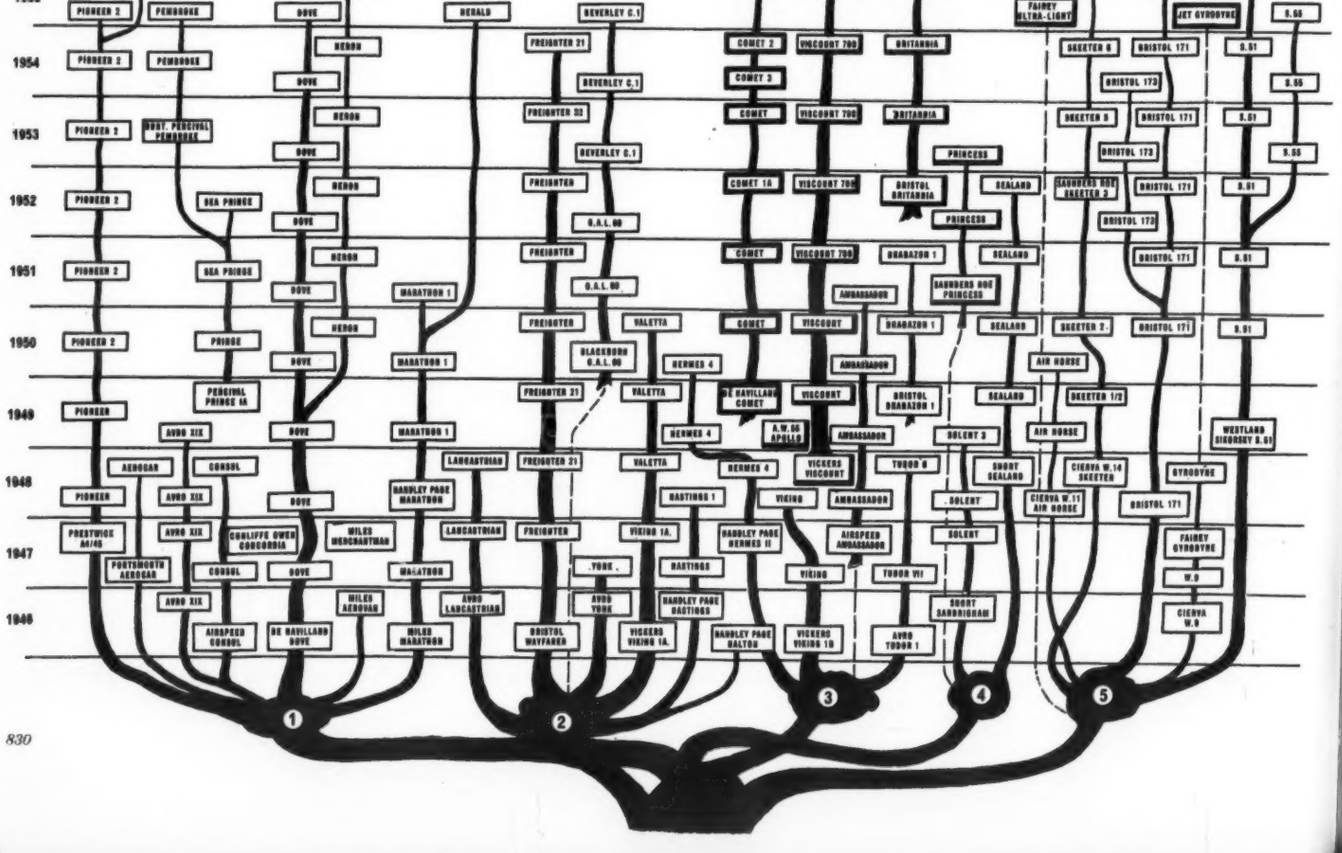
TABLE III: MAJOR BRITISH EXPERIMENTAL AIRCRAFT OF THE LAST TEN YEARS.



▲ Aircraft for aerodynamic research. ● Flying test beds for new engines. ■ Flying laboratories for testing new equipment and accessories.

TABLE IV: Genealogical tree of British *civil aircraft:* 1 — light and medium types; 2 — converted military transports and bombers; 3 — medium and long-range aircraft; 4 — amphibians and flying boats; 5 — rotary-wing aircraft.

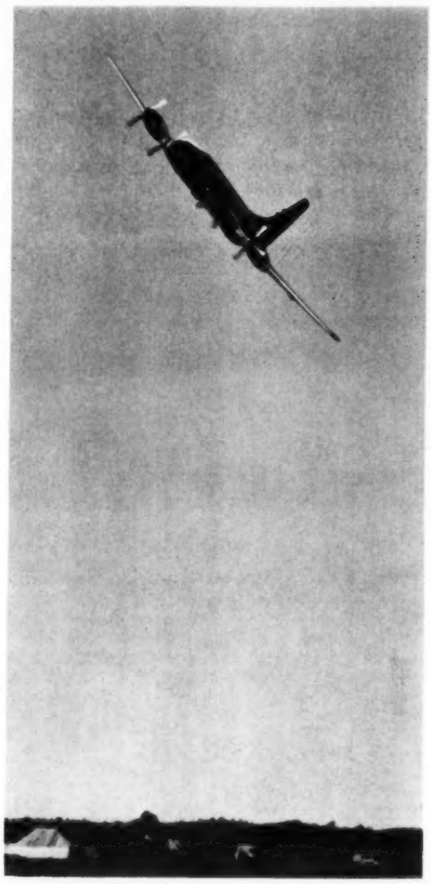
Piston-engine aircraft. Turboprop aircraft. Turbojet aircraft.



• 2. Disregarding the first two aircraft mentioned—the temporary failure of the third does not condemn the general formula—and examining the fate of the aircraft designed during the period when the heritage of the war years was being gradually liquidated, it will be seen that all have made their way, and rejects have been few. Percival *Prince*, de Havilland *Dove* and *Heron*, Vickers *Viscount*, Bristol 170 are used successfully in their various versions both in Britain and abroad. Miles *Marathon*, Airspeed *Ambassador*, Short *Sealand* and Blackburn *Beverley* have all been ordered either at home or elsewhere. Apart from the giants hampered by their very size and, for example, the Armstrong Whitworth *Apollo*, which was an unsuccessful but nearly equal rival to the *Viscount*, there have been few designs that have not made the grade. If there was a critical period on the commercial side, it was reflected by the Radlett Displays of 1946 and 1947, with their multitude of projects abandoned in the prototype stage or dragged on from year to year until the appearance of designs of real commercial value. Recent Displays, on the other hand, have underlined Britain's concentration on the half dozen civil aircraft capable of meeting domestic and foreign needs.

• 3. The policy followed in the matter of rotary-wing aircraft was also a somewhat audacious one in the early days; the Fairey *Gyrodyne* of 1947 and the Cierva *Air Horse* of 1949 have been sent back to the drawing board or put into cold storage. On the other hand, Bristol, patiently improving a mechanical helicopter of simple design, have produced the *Sycamore* and acquired the experience necessary to pass on to the next stage with their twin-rotor Bristol 173. Meanwhile initial demand has been met by Westland building under Sikorsky licences. This year's Display marked the progress obtained in British rotary-wing designs, though commercially speaking it will not be possible to evaluate the effort made until the advent of the third stage, that of heavy helicopters. It will be seen that instead of experimenting with a wide variety of projects, some rational, others less so, as has been done in the United States and France, the British have been very careful, and their helicopter genealogical tree is reasonably small.

Prototype of the new, enlarged and structurally strengthened de Havilland *Comet* jet commercial transport, twenty of which are on order for B.O.A.C.

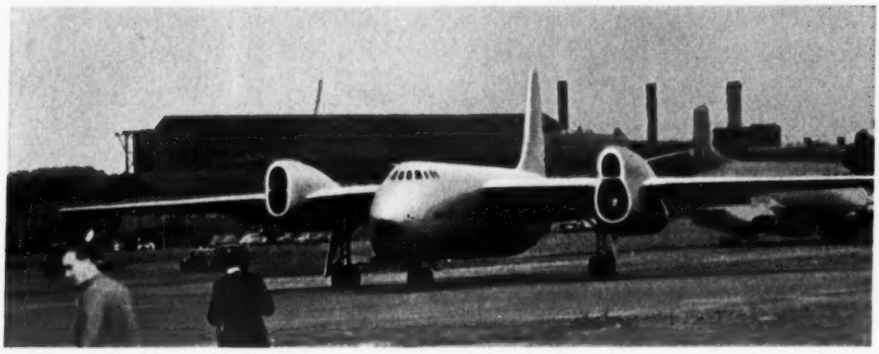


The four-engined Bristol *Britannia Mk. 100* turboprop commercial transport has seats for 42 first-class passengers and is destined for B.O.A.C.'s Dominion routes. – Later developments for 101 passengers *(Britannia Mk. 300)* and for mixed passenger/freight transport *(Britannia Mk. 250)* are in production.

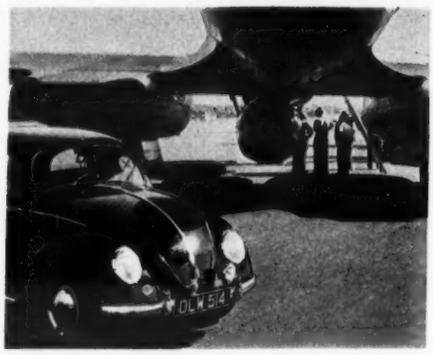
Coming direct from the Vickers assembly line, this 40/59-seat *Viscount* for Trans-Canada Air Lines arrived just in time for the 16th S.B.A.C. Display. Vickers-Armstrongs have so far received orders for more than 240 of these aircraft.

Practical experiment and flying test beds

Whether military or civil, these products of the British airframe industry have succeeded largely because of the quality of their power plants. Britain has put her best efforts into her aircraft engine industry. A rational policy, backed by wartime experience and a long engineering tradition, has led to the almost complete success of the programmes launched at the end of the war. Moreover, both responsible authorities and production engineers have recognized the essentials in the engine policy and rationally assembled the means of success. Here table III speaks volumes. It lists the various experimental equipment shown at successive Displays but certainly does not cover all the flying test beds used across the Channel. Most of them have been used for testing new power units. As early as 1946 the Rolls-Royce *Nene*, de Havilland *Ghost* and Bristol *Theseus* were already running in flying test beds. The R.-R. *Avon* appeared the next year in an Avro *Lincoln*. In 1949 came the Armstrong Siddeley *Mamba* and the Rolls-Royce *Dart* and afterburner devices. Every year since then flying test beds for engines have been put into the British industry's "shop window," foreshadowing four or five years in advance the aircraft of the next generation. Aerodynamic research has also used similar methods of experiment. One of the features of British aeronautical development is that it has been based on the experimental method rather than solely on the results of calculation or laboratory and wind tunnel tests. Or, to put it more accurately, it has been recognized that the latter do not go far enough, and that full-scale tests are needed as well. The system has been criticised for its heavy cost and the time it consumes. But it has definitely contributed to the quality of British engines and to the aerodynamic success of many prototypes. The design of the *Comet*—of whose high aerodynamic qualities there has never been any question—owes much to the D.H. 108, and the *Vulcan* would not



The Short *Sperrin* flying test bed is at present being used to test the de Havilland *Gyron* super-powerful axial-compressor turbojet (16,000 lbs. thrust) which is mounted in the lower port nacelle.



Another flying test bed, the Avro *Ashton*, is testing the 13,000 lbs. s. t. Rolls-Royce *Conway* by-pass engine (underneath the fuselage).

have succeeded at "first go" if it had not been preceded by the Avro 707 delta-wing models.

There is little to criticise in either British engineering or the method followed. Much has been said about dispersion of effort, but this criticism does not tie in with the need to export and hence to meet a whole range of requirements that of necessity fall outside those of the United Kingdom itself. There have been assertions of excessive daring, but these have been invalidated by the gradual development of aircraft patiently derived one from another. The fact is that, though the main effort has been rational, there have been marginal excesses, with overhaste and over-confidence in one domain and over-prudence in another. The last Government White Paper shows that this lesson has been learnt. Engines such as the Bristol BE.25 and Rolls-Royce RB.109, or the D.H. *Gyron*, R.-R. *Conway* and Bristol *Orpheus* which flew this last September, indicate the possibilities open to British industry in the years to come. The completion of the technical cycle will doubtless bring forth some extremely interesting equipment for presentation at Farnborough in 1958 or 1959.

The British Aircraft Industry's Post-War Exports

The total value of all aeronautical exports from Britain between January 1946 and June 1955 (see graph below) amounted to £372,000,000 in round figures. About half this sum is for complete aircraft (broken curve), the rest for engines, equipment and accessories. Annual value of exports rose from only £ 14,500,000 in 1946 to £ 65,000,000 in 1953, then dropped back to £ 56,300,000 in 1954, but is expected to reach a new high level in 1955.

What aircraft were exported, and where they went is shown by the table on the next page. It covers practically all the countries of the world, except the Soviet Union which merely took a few British jet engines (R.-R. *Nenes* and *Derwents*) shortly after the war. Understandably the Dominions (Australia, Canada, India, New Zealand, Pakistan, South Africa) and the Crown Colonies and Protectorates are the chief customers for the Home Country's aeronautical products. However, the British aircraft industry's exports to Argentina, Belgium, Brazil, Denmark, Egypt, France, Holland, Iraq, Israel, Italy, Japan, Norway, Peru, Spain, Sweden, Switzerland, Turkey and Venezuela should not be overlooked. Even the United States has bought 65 Vickers *Viscount* turboprop aircraft and a large number of de Havilland *Dove* and *Heron* light transports.

A true picture of British efforts must also include mention of the large part played by "invisible exports"—the sale of licence rights for aircraft and engines. Up to the present the following licences have been granted:

Australia: de Havilland *Vampire* trainer, English Electric *Canberra* bomber, Rolls-Royce *Avon* jet engine (fitted to English Electric *Canberra* and Commonwealth CA-27 *Sabre*.)

Belgium: Hawker *Hunter* fighter, Rolls-Royce *Avon* jet engine.

Canada: Bristol *Britannia* maritime reconnaissance aircraft (built by Canadair as CL-28).

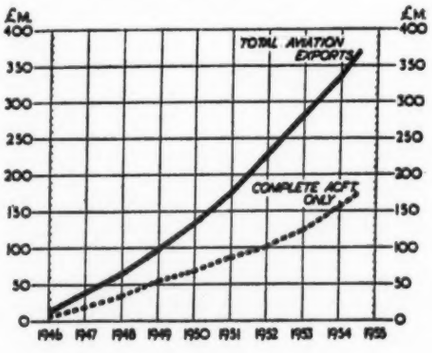
France: Bristol *Hercules* piston engine (fitted to Nord *Noratlas* military transport), Rolls-Royce *Tay* jet engine (fitted to Dassault *Ouragan* interceptor fighter and Dassault *Mystère* 4N supersonic fighter), de Havilland *Sea Venom* naval fighter (*Aquilon*), Armstrong Siddeley *Viper* jet engine (fitted to S.N.C.A.S.O. *Trident* interceptor/research prototype), Rolls-Royce *Avon* jet engine.

Holland: Hawker *Hunter* fighter.

India: de Havilland *Vampire* trainer, Hunting Percival *Prentice*.

Italy: de Havilland *Vampire* fighter, de Havilland *Goblin* jet engine, de Havilland *Ghost* jet engine (for French-built de Havilland *Sea Venom/Aquilon*).

Cumulative value of British aircraft industry exports from January 1946 to June 1955.



Portugal: de Havilland *Chipmunk* trainer.

Sweden: de Havilland *Ghost* jet engine (fitted to Saab 29 fighter), de Havilland *Goblin* jet engine, Rolls-Royce *Avon* (fitted to Saab *Lansen* fighter).

Switzerland: de Havilland *Vampire* fighter, de Havilland *Venom* fighter-bomber, de Havilland *Ghost* jet engine.

Turkey: de Havilland *Gipsy Major* piston engine (fitted to several Turkish-built light transports and trainers).

U.S.A.: Bristol *Olympus* jet engine built by Curtiss-Wright as the J-67 (fitted to the Republic XF-103, a very advanced experimental interceptor), English Electric *Canberra* B2 bomber (built by Martin as B-57), Rolls-Royce *Tay* jet engine built by Pratt & Whitney as J-48 *Turbo Wasp* (fitted to Grumman F9F-5 *Panther* and F9F-8 *Cougar*, and Lockheed F-94C *Starfire*), Rolls-Royce *Nene* jet engine built by Pratt & Whitney as J-42 (fitted to Grumman F9F-2 *Panther*), Armstrong Siddeley *Sapphire* jet engine built by Curtiss-Wright as J-65 (fitted to Douglas A4D *Skyhawk*, Grumman F11F *Tiger*, Lockheed F-104, Martin B-57 *Canberra*, North American FJ-3 and 4 *Fury*, Republic F-84F *Thunderstreak* and RF-84F *Thunderflash*), Armstrong Siddeley *Python* turboprop, Armstrong Siddeley *Mamba* turboprop, Armstrong Siddeley *Double Mamba* turboprop, Armstrong Siddeley *Viper* jet engine.

In 1954 British aviation exports (£56,300,000) ranked fourth among industrial products, coming after cars (£118,500,000), commercial vehicles (£68,100,000) and electrical machinery (£59,000,000). Today the aircraft industry employs nearly 250,000 persons, or about 100,000 more than in 1950.

Britain's Post-War Exports of Civil and Military Aircraft

(Prepared from S. B. A. C. figures for September 1955)

COUNTRY OR GROUP OF COUNTRIES	COMMERCIAL TRANSPORTS													TRAINERS TOURERS				PISTON-ENGINED MILITARY				TURBOJET AND TURBO-PROP MILITARY								HELI-COPTERS			
	Bristol *Britannia*	Bristol 170 *Freighter*	De Havilland *Dove*	De Havilland *Heron*	De Havilland *Comet*	Handley Page *Herald*	Handley Page *Marathon*	Hunting-Percival *Prince* & *Pembroke*	Short *Sealand*	Short *Sunderland*	Vickers *Viking*	Vickers *Viscount*		Auster *Aiglet* & *Autocar*	De Havilland *Chipmunk*	Hunting-Percival *Prentice* & *Provost*	Other tourers	Piston-engine fighters	Avro *Lancaster* & *Lincoln*	Fairey *Firefly*	Handley Page *Halifax* & *Hastings*	De Havilland *Vampire*	De Havilland *Venom*	English Electric *Canberra*	Fairey *Gannet*	Gloster *Meteor*	Hawker *Hunter*	Short *Seamew*	Vickers-Supermarine *Attacker*	Bristol 171	Westland-Sikorsky S-51	Westland-Sikorsky S-55	Other helicopters
1. Afghanistan	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2. Arabia	—	×	—	1	—	—	—	—	—	—	—	—		×	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3. Argentina	—	×	×	—	—	—	—	—	—	—	×	—		21	×	100	—	—	30+	—	—	—	—	—	—	100	—	—	—	—	—	—	—
4. Austria	—	—	—	—	—	—	—	—	—	—	—	★		1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5. Belgium	—	—	×	—	—	—	—	×	—	—	—	—		—	×	—	—	×	—	—	—	—	—	—	—	×	×	—	—	3	—	—	—
6. Belgian Congo	—	—	×	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—
7. Brazil	—	×	×	2	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	70	—	—	—	—	—	—	—
8. British Dominions	★	×	×	15+2	24	—	—	13	16	24	48			31+×	—	×		×	×	×	×	×	—	3	40	×	—	★	×	×	—	—	×
9. British Crown Colonies and Protectorates	—	×	×	8	—	—	6	6	—	—	×	11		5	—	×	×	×	—	—	—	×	—	—	—	—	—	—	—	—	—	2	—
10. Burma	—	×	×	—	—	—	3	—	—	—	—	3		—	—	×	—	×	—	—	—	8	—	—	—	—	—	—	—	—	—	—	—
11. Chile	—	—	×	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—
12. Colombia	—	—	—	—	—	×	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13. Czechoslovakia	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14. Denmark	—	—	—	—	—	—	—	—	—	—	5	—		—	×	—	—	—	—	30	—	—	—	—	—	20	30	★	—	—	—	—	—
15. Ecuador	—	×	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—
16. Egypt	—	—	×	—	—	—	—	—	1	—	2	3		—	×	—	—	×	×	—	×	×	—	—	—	×	—	—	—	—	2	—	—
17. Eire	—	4	—	—	—	—	—	—	—	—	7	4		—	×	×	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18. Ethiopia	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	9	—	—	—	—	—	—	—	—	—	—	—	—	—
19. Finland	—	—	—	—	—	—	—	×	—	—	—	—		—	—	2	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—
20. France	—	×	—	9	6	—	—	—	—	—	—	12		×	—	—	×	×	59	—	×	×	×	×	—	×	—	—	—	—	—	6	—
21. French Colonies	—	2+	—	—	—	—	—	—	—	—	—	—		—	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	9	—	—
22. Holland	—	—	—	—	—	—	—	—	1	—	—	9		—	—	—	×	×	—	9	—	—	—	—	—	×	×	★	—	—	—	2	—
23. Indonesia	—	—	—	14	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
24. Iraq	—	×	×	—	—	—	—	—	—	—	3	3		—	—	×	—	×	—	—	—	×	×	—	—	—	—	—	—	—	4	—	—
25. Israel	3	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	×	—	—	—	—	—	—	—	×	—	—	—	—	—	—	—
26. Italy	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	3	—	—
27. Japan	—	—	4	3	—	—	—	—	—	—	—	—		×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—
28. Lebanon	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—
29. Norway	—	—	—	2	—	—	—	—	2	—	—	4		—	—	—	—	×	—	—	—	×	—	—	—	—	—	—	—	—	1	1	—
30. Peru	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	20	—	—	—	—	—	—
31. Poland	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
32. Portugal and Colonies	—	—	×	—	—	—	—	—	—	—	—	—		—	—	—	—	×	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—
33. San Domingo	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
34. Spain	—	8	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35. Sudan	—	—	×	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
36. Sweden	—	×	×	—	—	—	—	×	—	—	—	—		2	—	—	—	×	—	12	—	×	×	—	—	—	120	—	—	—	—	—	—
37. Switzerland	—	—	—	—	—	—	—	1	—	—	—	—		—	—	—	—	—	—	—	—	×	×	—	—	—	—	—	—	—	—	—	—
38. Syria	—	—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	×	—	—	—	—	—	—	—
39. Thailand	—	—	—	—	—	—	—	×	—	—	—	—		—	×	—	—	—	—	12	—	—	—	—	—	—	—	—	—	—	4	—	—
40. Turkey	—	—	—	7	—	—	—	—	—	—	—	—		—	—	—	—	×	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
41. Uruguay	—	—	—	4	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
42. United States	—	—	×	—	—	—	—	—	—	—	—	65		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
43. Venezuela	—	—	—	—	—	—	—	2	—	—	—	3		—	—	—	×	—	—	—	—	×	×	12	—	—	—	—	—	—	—	—	—
44. West Germany	—	—	—	—	—	—	—	—	—	—	—	★		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
45. Yugoslavia	—	—	—	—	—	—	—	—	×	—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—

× = no figures available ★ = under discussion

Scottish Aviation "*Twin Pioneer*" 14/16-seat short-stage transport (two Alvis *Leonides*) spreads its vast Fowler flaps and leading edge slots.

Farnborough in Pictures

"See you at Farnborough" has become one of the stock phrases of international aviation jargon. The display of aircraft, engines and equipment organized early in September every year by the Society of British Aircraft Constructors is in fact a recognized meeting place for aviation people of all nationalities.

The S.B.A.C. Display has two peculiarities, compared with other air shows: 1.—it is self-contained with its flying displays and static exhibition; 2.—"guest days" and "public days" are separate, and the first four days are kept clear of the general public. This gives industrialists and engineers, service officers and air transport men, many of whom come thousands of miles to Farnborough, ample opportunity to discuss new equipment or old problems in peace, without being disturbed by mass invasions of schoolboys or pilots' sweethearts. One disadvantage, however, is Farnborough's distance from London, which means that much time is wasted travelling to and fro by car or motor coach. But there is no other suitable airfield within reach of London that has the same facilities and parking space and as many approach roads. Farnborough is so well situated on these counts that permanent exhibition buildings, as at Le Bourget, will probably be built.

Farnborough is designed primarily as a "samples fair" for British firms wishing to export their products, but it is also the barometer for Britain's whole aeronautical development. In recent years this barometer has risen from "unsettled", through "changeable" to "set fair". One indication of this is provided by the fact that the number of exhibitors has risen from 115 at the first post-war Display (1946) at Radlett to 307 this year. A very large group of exhibitors today specialises, however, in aviation electronics and has thus virtually become a separate branch of industry.

The most important aircraft shown in flight—some of them new designs, others "old friends"—are illustrated by the pictures on these pages. They are divided into the following groups:

I—commercial transports;

II—military trainers and artillery observation aircraft;

III—helicopters;

IV—bombers and long-range reconnaissance aircraft;

V—naval aircraft;

VI—fighters and ground attack aircraft.

Technical details may be found in the October issue under the title "First Impressions of the 16th S.B.A.C. Display" and in the tabulation of British aircraft in No. 9, 1955.

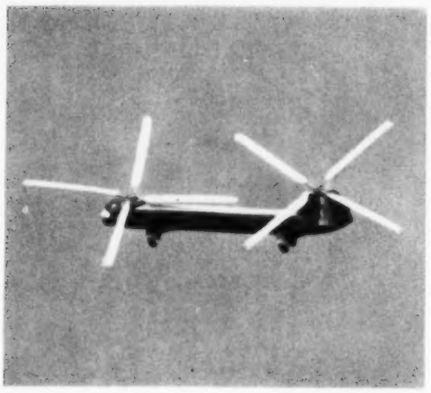
*

Prototype of the 36/44-seat Handley Page *Herald* (four Alvis *Leonides Majors*).

Parade of the "heavyweights" before the flying display: left, the four-jet (A. S. *Sapphire*) Handley Page *Victor* crescent-wing bomber, possibly the forerunner of a high-speed commercial transport; right the Bristol *Britannia Mk.100* with four turboprops (Bristol *Proteus 705*).

Hunting Percival *Provost* armed two-seat trainer (Alvis *Leonides*) in Iraqi colours.

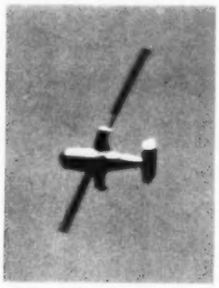
Westland *Widgeon* five-seat helicopter (Alvis *Leonides*).



The twin-rotor Bristol 173 (two Alvis *Leonides* or *Leonides Majors*).

The Auster A.O.P. 9 artillery observation aircraft (Blackburn *Cirrus Bombardier*).

The experimental Fairey *Jet Gyrodyne* (one Alvis *Leonides*; two *Merlin*-type supercharger blowers) has two pusher propellers at the ends of its stub wings and combustion nozzles at the rotor blade tips.



The *Jet Gyrodyne* in flight.

Hunting Percival *Jet Provost* two-seat trainer (one A.S. *Viper ASV. 5*) in a new version: shorter undercarriage, longer jet pipe, larger flaps.

Fairey's ultra-light helicopter for Army use (Blackburn-Turboméca *Palouste*; turbo compressor) with compressed air nozzles at the rotor blade tips.

The first nine aircraft of the group demonstrations have just landed: left to right: Hunting Percival *Provost* and *Pembroke*, de Havilland *Heron*, and *New Elizabethan* with Napier *Eland*.

Extra door in the nose of the Westland *Widgeon* (derived from the Sikorsky S-51); new rotor head with redesigned transmission system.

Pilots of the 16th S.B.A.C. Display

Allam, J. W., F/L. (Victor)

Auty, G. (Olympus-Canberra)

Baker, J. D. (Shackleton)

Beamont, R. P., W/C. (English Electric P.1)

Bedford, A. W. (Hunter F.4)

Bois, P. (Comet 3)

Bradley, R., Lt. Cdr. (Widgeon)

Bryce, G. R., (Valiant)

Bugge, P. (Comet 3)

Bullen, F. (Hunter 6)

Capper, N. J., W/C. (Twin Pioneer)

Cartwright, H. K. (Eland-Elizabethan)

Cunningham J., G/C (Comet 3)

Duke, N., S/L (Hunter)

Eassie, W. J. D., (Seamew)

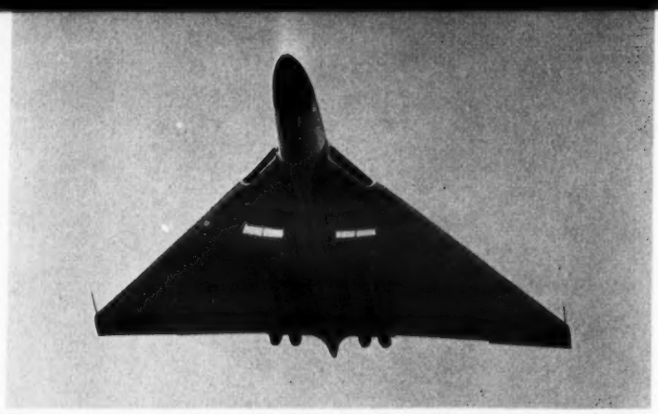
Elliot, J. Lt.Cdr. (D. H. 110)

Falk, R. J., W/C. (Vulcan)

Gellatly, W. R., S/L. (Ultra Light Helicopter)

Gibb, W. F., W/C. (Olympus-Canberra)

Hazelden, H. G., S/L. (Herald)



The powerful Avro *Vulcan B. 1* V-Bomber (four Bristol *Olympus*) in low-speed flight. The bomber afterwards made a series of impressive climbing rolls.

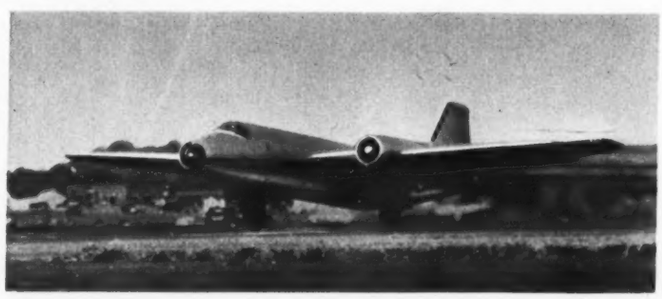
The crescent-wing Handley Page *Victor B. 1*, latest of the V-bombers (four A. S. *Sapphires*), with extended leading and trailing edge flaps, approaching to land in almost horizontal attitude.

The Avro *Vulcan*, on the other hand, lands at a very high angle of incidence.

Air brakes in the H. P. *Victor* are fitted to the fuselage rear.

First of the V-bombers, the Vickers *Valiant B. 1* (four R.-R. *Avon RA. 14s*) is in squadron service.

The English Electric *Canberra PR. 9* long-range reconnaissance aircraft (two R.-R. *Avons*), latest version of the proven bomber and ground attack aircraft, takes off for an aerobatics demonstration.



Pilots of the 16th S.B.A.C. Display

Hillwood, P., F/L. (Canberra P.R.9)

Hosegood, C.T.D., (Bristol 173)

Ingle-Finch, M., W/C., (Seamew)

Kempster, J. (Seamew)

Lithgow, M.J., Lt.-Cdr. (Swift F.R.5)

Masters, D. (Gannet Trainer)

Moore, P. (Sycamore)

Morton, J.G.P. Lt.-Cdr. (Gyrodyne)

Oliver, S. B. (Pembroke)

Pegg, A.J. (Britannia)

Pike, G.H. (Heron 2)

Porteous, R., S/L. (Auster A.O.P.9)

Randrup, M., S/L., (Eland-Elizabethan)

Runciman, W.J., S/L. (Seamew)

Smith, B., F/L. (Javelin)

Smith, R., Capt. (Pioneer)

Taylor, D.B., (Heron 2)

Tennant, E.A., S/L. (Gnat)

Trubshaw, E.B. (Valiant)

Twiss, P.(F.D.2)

Varley, P., (Javelin)

Wheldon, R.G. (Jet Provost)

Worrall, G., F/O (Javelin)

Zurakowski, J., S/L. (CF-100)

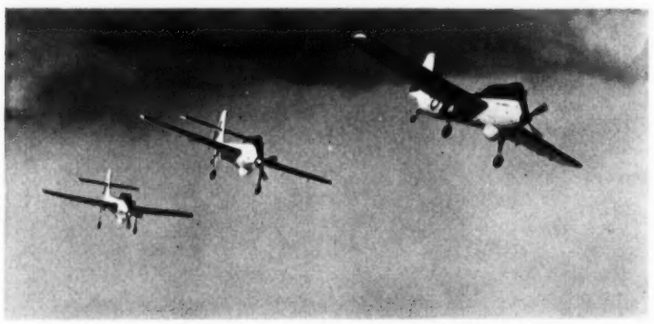
MILITARY RANKS (R.A.F.)

P/O	= Pilot Officer	= Second Lieutenant
F/O	= Flying Officer	= First Lieutenant
F/L	= Flight Lieutenant	= Captain
S/L	= Squadron Leader	= Major
W/C	= Wing Commander	= Lieutenant Colonel
G/C	= Group Captain	= Colonel

ROYAL NAVY

S/Lt.	= Sub Lieutenant
Lt.	= Lieutenant
Lt. Cdr.	= Lieutenant Commander
Cdr.	= Commander

The manœuvrable Short *Seamew* light-weight anti-submarine aircraft (A. S. *Mamba*) in slow flight. Radar search equipment under the nose.



The Short *Seamew* appeared for the first time in formation at Farnborough.

Avro *Shackleton Mk. 3* long-range sea reconnaissance and anti-submarine aircraft (four R.-R. Griffons) with nose-wheel under carriage.

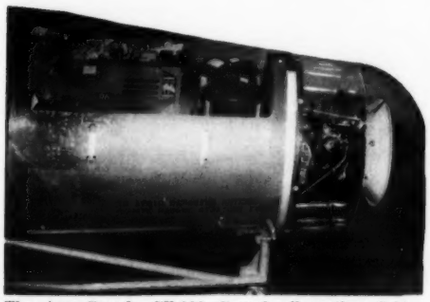
Used as carrier-based all-weather fighter, guided missiles carrier and naval combat aircraft: de Havilland D. H. 110 (two R.-R. *Avons*).

T. 1 trainer version of the Fairey *Gannet* naval fighter (A. S. *Double Mamba*): wing folded at two points (power-operated) with engine running.

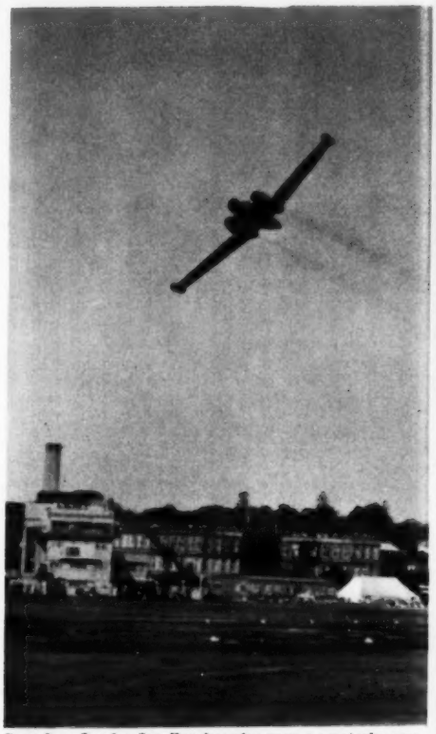
Farnborough

Aerobatics wing of No. 54 Squadron in Hawker *Hunter* interceptors.

The "hit" of Farnborough 1955 was the English Electric P. 1 twin-jet supersonic fighter (two A. S. *Sapphires*), shown here in a slow run.



The Avro-Canada CF-100 *Canuck* all-weather fighter carries Howard Hughes fire control radar in the nose.



Squadron Leader Jan Zurakowsky gave a masterly aerobatic display in the CF-100 *Canuck Mk. 4* twin-jet all-weather fighter (two Avro *Orenda 11s*), designed by A. V. Roe Ltd.'s Canadian associate.

Folland *Gnat 1* light-weight fighter (Bristol *Orpheus*) landing with the aid of a brake parachute.

New-type muzzle gas deflectors on the Folland *Gnat's* two 30-mm cannon

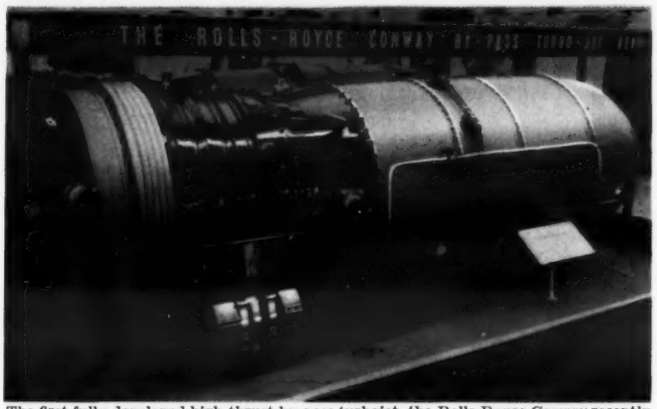
The fastest aircraft in the Display was the Vickers-Supermarine *Swift F. R. 5* ground attack and armed reconnaissance model with afterburner (R.-R. *Avon*, two 30-mm cannon, three cameras).

A batch of Gloster *Javelin* all-weather fighters ready for delivery (two A. S. *Sapphires*). Only one was shown at Farnborough this year.

Fairey FD. 2 experimental supersonic prototype (Rolls-Royce *Avon* with reheat) taking off for a subsonic demonstration flight.

Fairey FD. 2 landing – with nose lowered – using three brake parachutes simultaneously to shorten its landing run.

De Havilland *Gyron*, the most powerful turbojet in the world today with its static thrust of 16,000 lbs., is designed for a new Saunders-Roe supersonic stratospheric fighter.

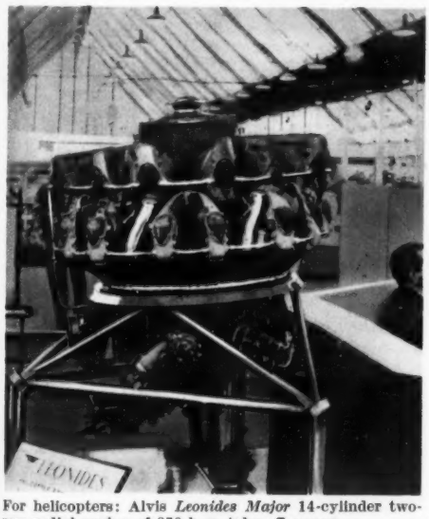


The first fully-developed high-thrust by-pass turbojet, the Rolls-Royce *Conway* recently was officially certificated for a thrust of 13,000 lbs. It is remarkable for its extremely low specific fuel consumption.

Snapshots of the Engine Display

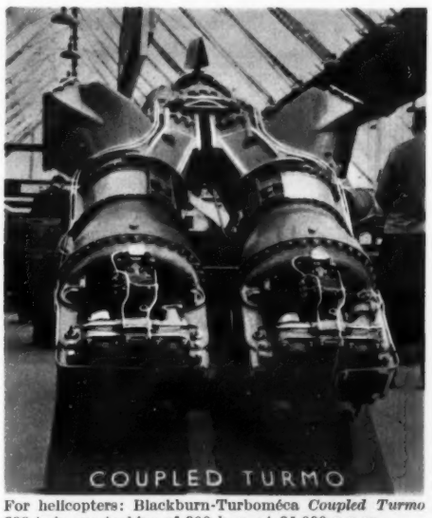
For the engineer the 1955 Farnborough Display was primarily an engine show: British aircraft engines today cover the whole power range from small gas turbines and sports piston engines to the Western world's most powerful type-tested turbojet of the present day, the 16,000-plus lbs. thrust de Havilland *Gyron*.

In considering this year's new engine models—the Rolls-Royce *Conway* and D.H. *Gyron* in the first line—it should be recalled that every new British engine is tied in with an aircraft prototype for which there is a Government-sponsored development programme. The Rolls-Royce *Conway* by-pass turbojet appears to have been designed primarily for the Vickers 1000 military transport project, while the super-powerful D.H. *Gyron*, along with the Armstrong Siddeley *Spectre* rocket motor, for a new supersonic stratosphere fighter with mixed propulsion—a Saunders-Roe project. In the same way the Napier *Gazelle* gas turbine should be considered primarily for a development of the Bristol 191 helicopter, the Napier *Oryx* for the Hunting Percival P.74 and P. 105 helicopters, the Bristol *Orpheus* for light-weight fighters, the BE. 25 turboprop for *Britannia LR* commercial transports, the Rolls-Royce RB 109 turboprop for the "Viscount Replacement", etc. Finally, new versions of the Bristol *Olympus* turbojet are destined for a projected Gloster supersonic all-weather fighter, and the economical *Avon RA.29* will power the *New Comet*.



For helicopters: Alvis *Leonides Major* 14-cylinder two-row radial engine of 870 h. p. take-off power.

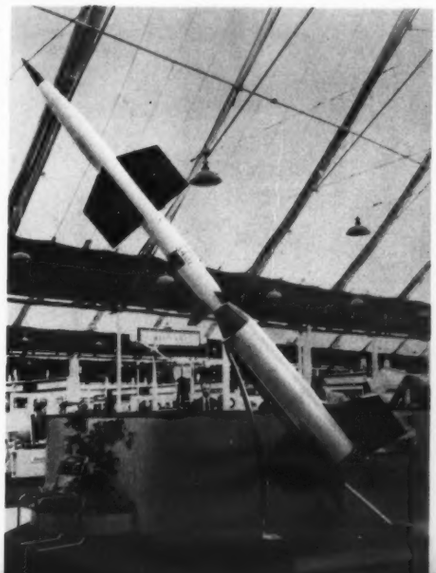
For helicopters and fixed-wing aircraft: Alvis *Leonides* radial engine (540 h. p.; behind); Alvis *Leonides Major* two-row radial (870 h. p.).



For helicopters: Blackburn-Turboméca *Coupled Turmo 600* twin gas turbine of 900 h. p. at 35,000 r.p.m.

De Havilland *Super Sprite* rocket motor for hydrogen peroxide (with solid catalyst) and kerosene or petrol injection; max. thrust 4,200 lbs.; total duration 40 seconds.

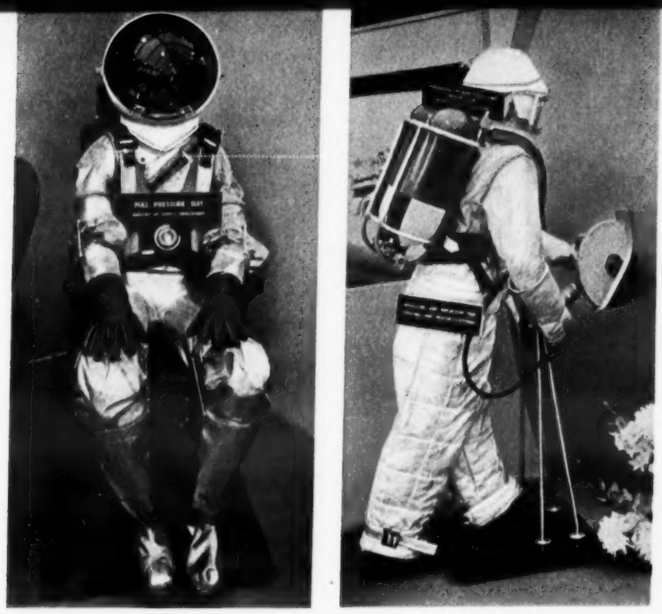
Fairey experimental supersonic rocket, with large booster rocket.



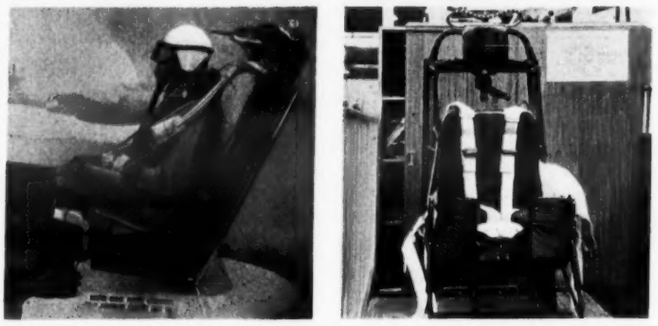
Rover 1 S/60 small gas turbine, with British Thomson-Houston LA 3016 D.C. dynamo to supply current for aircraft electrical systems.

Farnborough

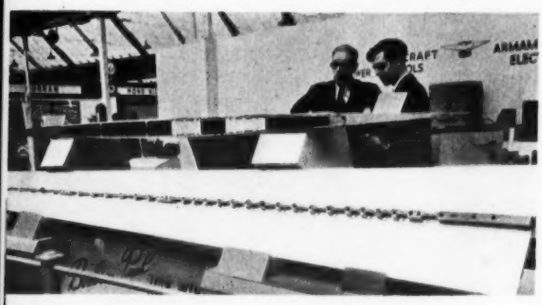
Safety Equipment, Airframe and Engine Accessories



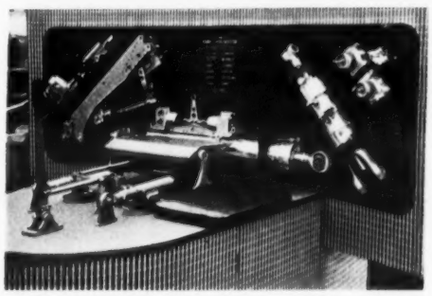
Left, a full pressure suit developed by the *Ministry of Supply* for stratosphere pilots (and space travellers); right, a fire-fighting suit with helmet, pneumatically operated hand saw and compressed air bottles (also a M.o.S. development), on the stand of *Siebe, Gorman & Co., Ltd.*



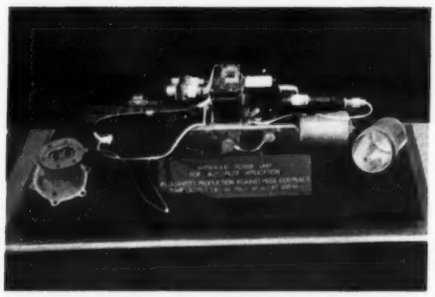
Left, the *Martin-Baker Aircraft Ltd.* fully-automatic light-weight ejection seat (Mark 4); right, the *Folland Aircraft Ltd.* automatic light-weight ejection seat (type 3A) for the *Gnat* light fighter. (The latter seat is a joint development by Folland and Svenska Aeroplan A.B., Linköping.)



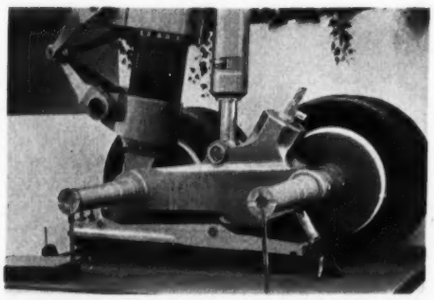
New integral structure for thin supersonic wings developed by *Boulton Paul Aircraft Ltd.* Each wing (shown in section above) is screwed together from twelve extruded light metal elements.



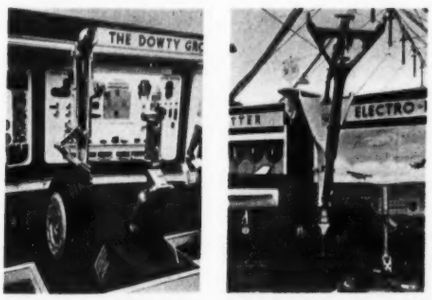
Fairey's "Hydrobooster" powered controls, as fitted to Avro CF-100 *Canuck*, Blackburn *Beverley*, Fairey *Gannet*, Hawker *Hunter* and *Sea Hawk* and Vickers Supermarine *Swift*.



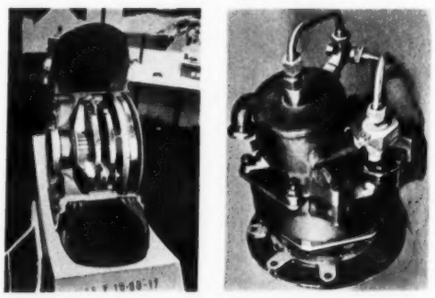
Hydraulic power supply group (with electric motor) for automatic pilots, produced by *Electro-Hydraulics Ltd.* The toothed-wheel pump of the group delivers up to 2.8 cu. ins./sec. of hydraulic fluid at 600 p.s.i. output pressure.



Runway brake designed by *Dowty Equipment* consists of steel shoe, synthetic rubber pads and hydraulic jack, and grips directly the concrete surface of the runway. It was demonstrated on a "working model" of the Avro *Vulcan's* eight-wheel main undercarriage unit (with outer double wheels removed).



Left, undercarriage for the Hawker *Hunter* interceptor, made by *Dowty*; right, *Electro-Hydraulics'* main undercarriage unit developed for the Handley Page *Herald* four-engine medium-stage commercial transport.



Goodyear disc brake with automatic brake control (left) and *British Thomson-Houston* propyl nitrate starter (right). Picture shows actual starter unit, which is mounted directly on the engine shaft.

V.I.P.'s at Farnborough: Unfortunately it was not possible to photograph all S.B.A.C.'s 6,000 invited guests. Such as chance brought before the camera are shown in the following series of pictures: **1** Left to right, Sir Roy Dobson (Managing Director, A.V. Roe and Co. Ltd.), Sir Frank Spriggs (Managing Director, Hawker Siddeley Group), Sir Sydney Camm (Chief Designer, Hawker Aircraft). **2** Rear Admiral Sir Matthew Slattery (Chairman and Managing Director, Short Brothers and Harland Ltd.). **3** Sir Reginald Verdon Smith (Managing Director, Bristol Aeroplane Co., with pipe). **4** Herbert Sammons (Managing Director, D. Napier & Son Ltd.). **5** Capt. Bennay (left) and Major G. Ruff.

1

2

3

4

5

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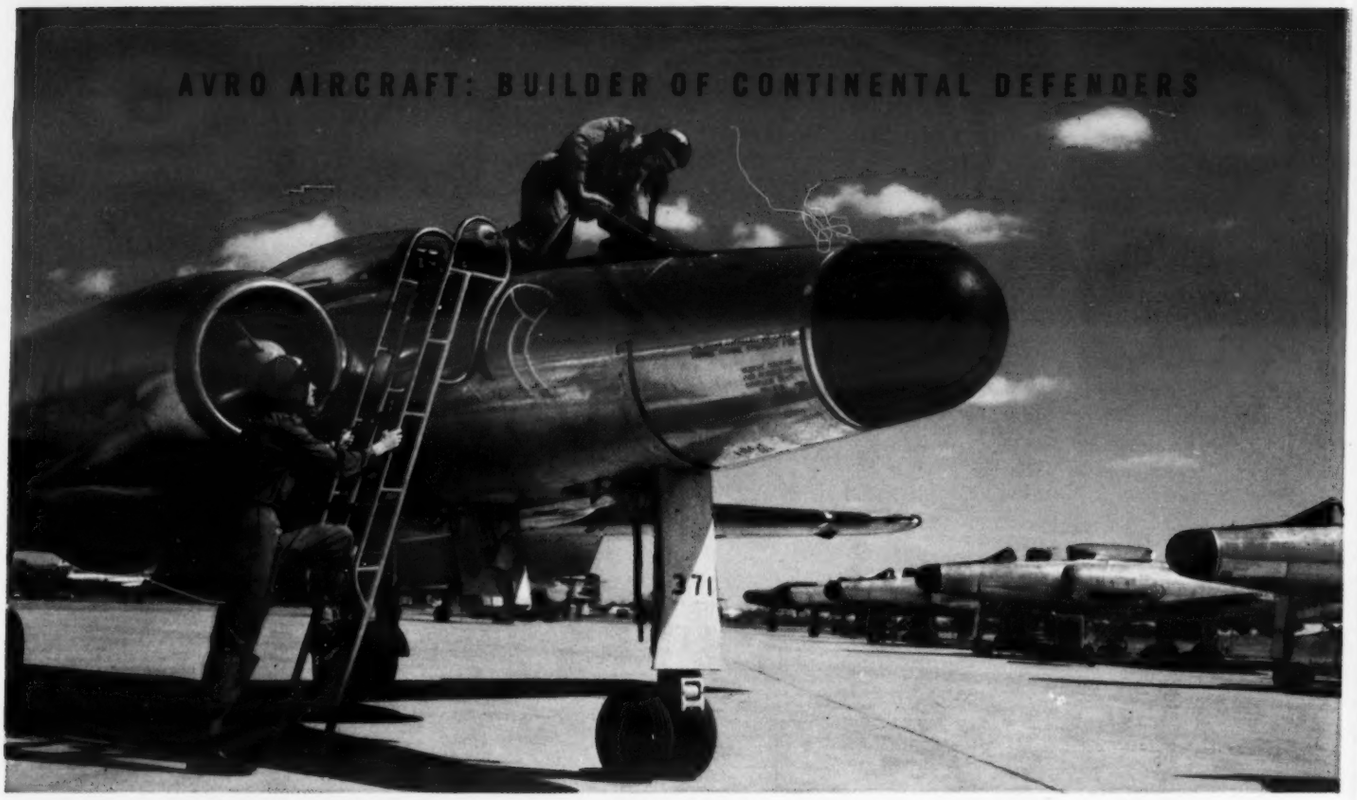
Speed Control Division, St. Augustine, Fla.
Stratos Division, Bay Shore, N. Y.



This highly skilled crew aboard Avro Aircraft's powerful CF-100 Mark 4 will soon be racing with sound up under the rim of the stratosphere.

. . . AS SURE AS NIGHT FOLLOWS DAY

Aggression recognizes no limitations of Time. Any hour can be Zero Hour.
That's why the Royal Canadian Air Force drew up specifications for a *night* and day interceptor . . . long range and all-weather, with the fire-power of a destroyer . . . to defend the skyways of its vast, northern frontier.
The specifications were met by Avro Aircraft Limited of Malton, Canada. The interceptor is the Avro CF-100.
No other *night* and day, *all*-weather interceptor in the *world* has its power and range.
At RCAF stations across Canada, around the clock, in the heat of Summer and frigid cold of Winter, collision course interception exercises with the Avro CF-100 keep RCAF pilots, navigators and ground crews alert against aggression.

AVRO AIRCRAFT LIMITED
MALTON, CANADA
MEMBER; A. V. ROE CANADA & THE HAWKER SIDDELEY GROUP

In RCAF operational multi-squadron service in Canada, squadrons of CF-100s will begin duty with NATO forces in Europe by 1956.

From Comox to Zweibrücken . . . and beyond

Orenda Power . . . and Orenda Service

Wherever Orenda engines go—driving the Sabre 5's and 6's on their NATO mission in Europe or the CF-100 all-weather interceptors of the RCAF patrolling our Far Northern frontiers—there goes Orenda Service . . . Technical service support of the highest calibre.

Orenda service teams today are stationed in the far Canadian north . . . in semi-tropical Africa . . . on RCAF air bases in Europe . . . in England . . . and soon will be in South Africa to assist in maintaining the Orenda-powered Sabre 6's recently ordered by the South African Air Force.

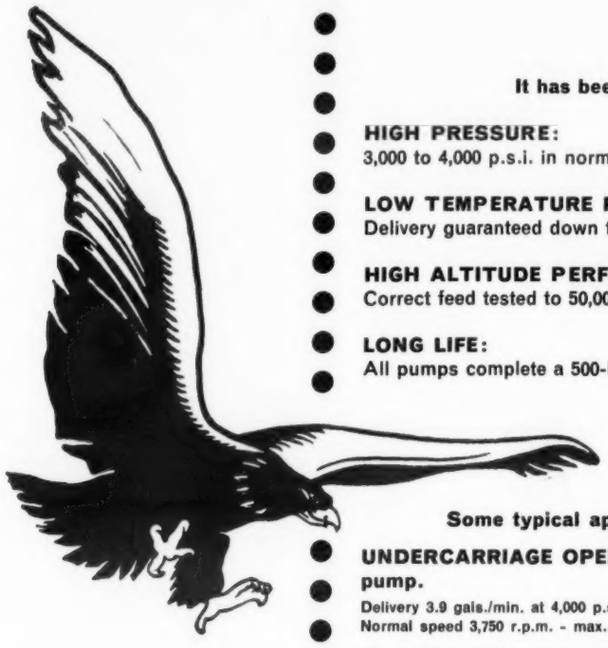
Trained at Orenda's Malton headquarters, and recalled regularly for refresher courses, the skilled engineers, technicians and mechanics who make up Orenda's field service team are key links in the complex organization charged with the defence of the free world today and for the future.

ORENDA

ENGINES LIMITED, **MALTON, CANADA**

MEMBER: A. V. ROE CANADA LIMITED & THE HAWKER SIDDELEY GROUP

There is a Messier Pump to meet each of your needs



It has been designed to ensure:

HIGH PRESSURE:
3,000 to 4,000 p.s.i. in normal service

LOW TEMPERATURE RELIABILITY:
Delivery guaranteed down to —40° C

HIGH ALTITUDE PERFORMANCE:
Correct feed tested to 50,000 ft.

LONG LIFE:
All pumps complete a 500-hour test

Some typical applications:

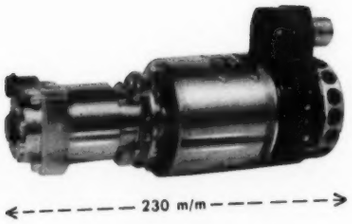
UNDERCARRIAGE OPERATION: Type 33 variable delivery pump.
Delivery 3.9 gals./min. at 4,000 p.s.i. - 5.3 gals./min. at 3,000 p.s.i.
Normal speed 3,750 r.p.m. - max. speed 4,000 r.p.m.

Type 40 variable delivery pump - delivery 0.9 gals./min. at 3.000 p.s.i.
Normal speed 6,850 r.p.m. - max. speed 7,100 r.p.m.

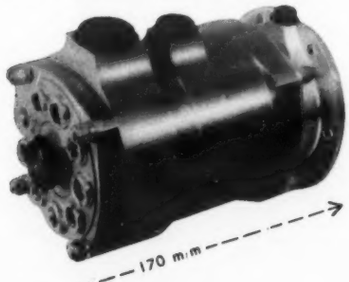
SERVO CONTROLS: Self-regulating electric pump.
Normal delivery 0.45 gals./min. at 3,000 p.s.i. - Normal speed 3,500 r.p.m.

Constant delivery pump -
normal delivery 0.9 gals./min. at 2,000 p.s.i. Normal speed 5,000 r.p.m.

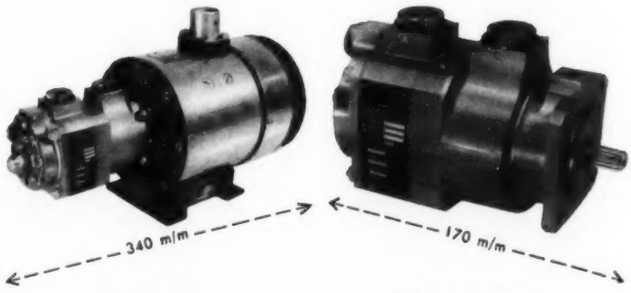
If none of the 20 types of MESSIER pumps already in service meet the SPECIAL PROBLEM you have to solve, MESSIER will design the NEW PUMP you require in 6 MONTHS.



Electric pump
Delivery 0.5 gals./min. at 4,650 r.p.m.
under a pressure of 1,920 p.s.i. (Mystère IV)



Self-regulating pump
Delivery 5,3 gals./min. at 3,750 r.p.m.
under a pressure of 3,000 p.s.i.



Electric pump
Delivery 0.9 gals./min. at 6,850 r.p.m.
under a pressure of 3.000 p.s.i. (Fouga 170 S)

Self-regulating pump
Delivery 0.9 gals./min. at 6,850 r.p.m.
under a pressure of 3,000 p.s.i.

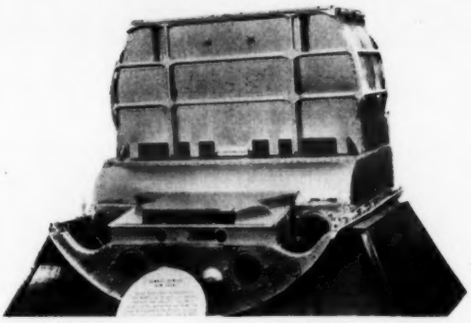
MESSIER

Specialists in undercarriages and high pressure circuits

58, RUE FÉNELON - MONTROUGE (SEINE) - ALÉ. 22-36

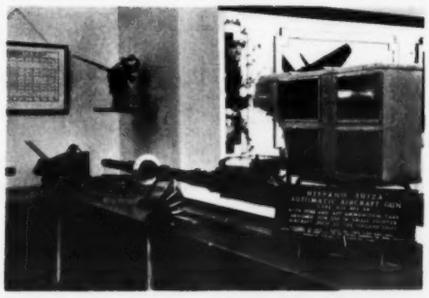
Target aircraft, guns, rockets

M.L. Aviation Co. Ltd.'s U. 120D Mk.2 remote-controlled target aircraft (65 h.p. Vincent *Picador* engine), with two three-inch booster rockets, shown on its launching rig.

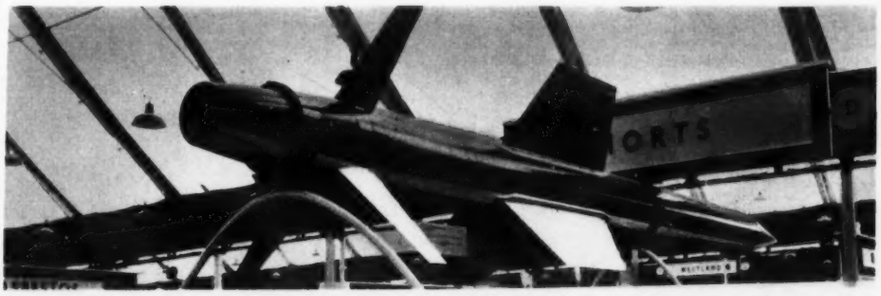


Gun pack for the four 30-mm cannon (*Aden*) in the *Hunter* interceptor, on *Hawker Aircraft Ltd.'s* stand.

One of the 30-mm *Aden* cannon which arm the Hawker *Hunter* (and other British fighters and ground attack aircraft).



British Manufacture & Research Company Ltd., an associate of Hispano Suiza, showed its HSS 825 30-mm aircraft cannon (left) and a HSS 805-AB 23-mm cannon (right). Rate of fire is 1,000 r.p.m. for the former and 1,100 r.p.m. for the second; muzzle velocity is given as 3,445 ft./sec and 2,850 ft./sec. Above the 30-mm cannon a low-resistance mounting for 80-mm Hispano Suiza HSS-R.80 rocket projectiles, with automatically retracting rear mounting.



Short Brothers and Harland supersonic General Purpose Vehicle; length 25 ft., diameter 17 ins.

Elliott Brothers (London) Ltd.'s semi-active radar homing head for an undisclosed anti-aircraft rocket.

V.I.P.'s at Farnborough: **6** Dr. S. G. Hooker (left: Chief Engineer, Engine Division, Bristol Aeroplane Co.) and Engineer Fala (Fiat, Turin). **7** Air Vice-Marshal Sir Conrad Collier (Director, D. Napier & Son Ltd.). **8** Air Chief Marshal Sir W. Alec Coryton (Managing Director, Engine Division, Bristol Aeroplane Co.). **9** R. V. Perfect (Director, Saunders-Roe Ltd.). **10** D. B. Smith (left; assistant to W.E.W. Petter, Folland Aircraft Ltd.) in conversation with Dr. V. M. Ghatage (Chief Designer, Hindustan Aircraft Ltd., Bangalore).

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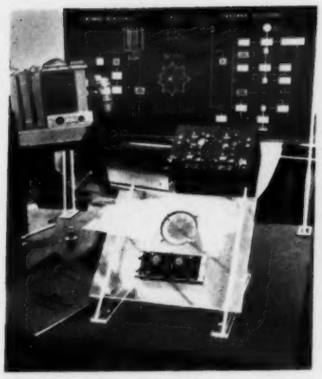
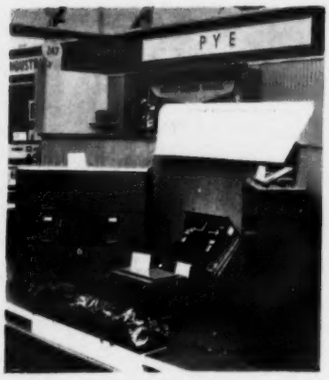
Aviation Electronics

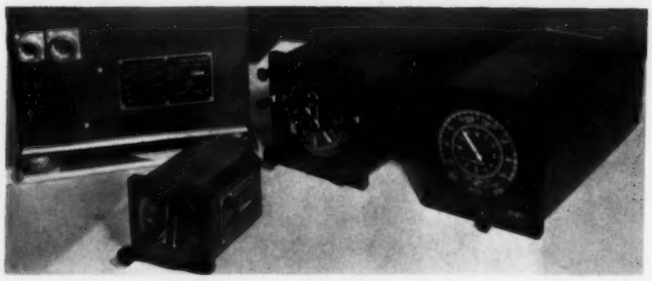
On one of the hills near the exhibition tent: aerial arrays for *Decca's* Q-band radar (left; for airfield surface movement control) and *Standard's* TACAN ground station (right; for radio navigation).



STARN.21 (TACAN) airborne station built by *Standard T. & C. Ltd.* (cf. *Interavia* No. 10, 1955, p. 792 etc.).

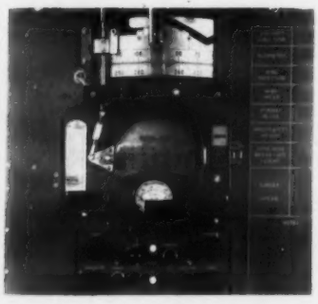


Cabinets of Pye Limited's newly developed Instrument Landing System (cf. *Interavia* No. 10, 1955, p. 791).



Electronic "R-Theta" computer of *PSC Applied Research Ltd.*, for permanent and instantaneous dead reckoning position fixing in the air, shown by *Hunting Percival*.

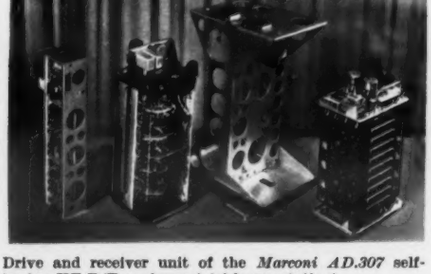
Aerial array and reflector for the *Cossor Mk.6* (primary) surveillance radar, with simultaneously-rotating secondary radar aerial (top).



Ekco Electronics Ltd.: Airfield Approach Radar CE.71 for one-man operation. – With both hands on the swivel controls, the controller reads distance and azimuth of a landing aircraft on the radar screen (centre) and the azimuth scale (top). As the approach aid is always positioned to one side of the runway in use, the aircraft's required azimuth for landing varies as a function of its distance from the equipment. An automatically adjusted transparent cursor over the radar screen enables constant comparison to be made between actual and required azimuth. The pilot is given course corrections and altitude instructions by R/T.

VHF D/F aerial (top) and radar aerial/reflector group of the Ekco approach aid rotate simultaneously with the cabinet inside the trailer.

Improved *Ekco airborne radar* for storm warning and map painting.



Drive and receiver unit of the *Marconi AD.307* self-tuning HF R/T equipment (airborne station).

Control unit and indicator of the *Marconi AD.210* VHF R/T D/F system (ground equipment).

V.I.P.'s at Farnborough: **11** Air Commodore Rodwell Banks (Director, Bristol Aeroplane Co.). **12** René Lucien (Chairman and Managing Director, Messier, Paris). **13** Professor Giuseppe Gabrielli (Manager of Fiat's Aircraft Division, Turin). **14** Mr. Cusson (Chief Designer, Dowty Equipment Ltd.). **15** Exhausted press photographers...

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Atomic Energy in Search of a Market

"The miraculous inventiveness of man shall . . . be consecrated to his life." Admiral Lewis L. Strauss, Chairman of the U.S. Atomic Energy Commission in front of a reproduction of the special stamp issued by the United States Post Office for the "Atoms for Peace" Conference.

"The United States pledges before you—and therefore before the world—its determination to help solve the fearful atomic dilemma—to devote its entire heart and mind to find the way by which the miraculous inventiveness of man shall not be dedicated to his death, but consecrated to his life.

"We have developed two new programs that I shall submit to the Congress in the conviction that they reflect the spirit and intent of law and of the American people:

"First, we propose to offer research reactors to the people of free nations who can use them effectively for the acquisition of skills and understanding essential to peaceful atomic progress. The United States, in the spirit of partnership that moves us, will contribute half the cost. We will also furnish the acquiring nation the nuclear material needed to fuel the reactor.

"Second, within prudent security considerations, we propose to make available to the people of such friendly nations as are prepared to invest their own funds in power reactors, access to and training in the technological processes of construction and operation for peaceful purposes... Our purpose is to spark the creative and inventive skills latent in the free world, to pool them and to put them to work for the betterment of the conditions under which men must live."

(From President Eisenhower's message to the United Nations in New York at the end of 1954.)

A historic event — the first atomic "trade fair" in Geneva

The U. S. President's message will go down in history as having initiated a train of development which has made 1955 a historic year in the application of atomic energy and taken the first step towards a revolution in world economies.

From August 8th to 20th, 1955, Geneva was the scene of two far-reaching events: the first international "Atoms for Peace" conference, organized by the United Nations, and the first international atomic exhibition, under the patronage of the Swiss Government.

The outer framework of the Conference was tellingly described by the special correspondent to the French weekly "Match": "It began in an atmosphere of well-being. Comfortably ensconced in deep cream leather chairs, 1,260 sorcerer's apprentices savoured the sweetness of their new-found clear consciences, after holding the threat of atomic war over the world for ten years. On August 8th, 1955, exactly ten years and two days after the explosion over Hiroshima, terror was suddenly changed into an idyll . . . Scientists from sixty-three countries revealed . . . secrets the least of which would have commanded a high price from any intelligence service less than a month before and would have meant the electric chair on the one side or a bullet in the back of the neck on the other for the man careless enough to be caught divulging it. Russians and Americans dined tête-à-tête . . . Relaxation of tension! The 1,260 delegates of atomic peace all breathed a sigh of relief . . . over the 1,139 reports that had been presented during the fourteen days—17,000 pages . . . or 36 kg of atomic secrets . . ."

"Match's" reporter had not missed the real surprise of the Conference: though the framework was scientific, the background was political, and the ultimate aim economic.

Another French reporter, representing the *Société d'Etudes et de Documentations Economiques,* commented on this surprise in somewhat blunt terms: ". . . Many of the scientists attending the conference . . . were surprised to find that their discussions were followed by groups of stock exchange experts who had come to Geneva from New York, London, Paris and other cities. Some described them as 'vultures come to exploit what we have done'. Others were less naive. Nobody at Geneva could overlook the marked spirit of rivalry which characterised the United States and United Kingdom exhibits in particular, and it was quickly realised that the two countries' official delegations were doing their utmost to help their commercial enterprises to cut a good figure in the eyes of possible customers . . ."

Atoms for Peace: Twelve hundred sorcerer's apprentices sat in cream-coloured leather chairs . . . opening session of the Geneva Conference on the Peaceful Uses of Atomic Energy *(United Nations picture).*

The German physicist *Professor Otto Hahn*, discoverer of nuclear fission, at a press conference in front of the globe in the gardens of Geneva's *Palais des Nations*.

There is no doubt about it, the Geneva meeting in August 1955 was historic. Before Geneva there was no market for atomic reactors or atomic energy—certainly no international market. Suddenly the nations came together to sell their ideas, even to engage in a kind of "slave traffic" as Americans, British, Russians and others offered experts to "underdeveloped" countries to initiate them into the secrets of the most revolutionary source of energy ever discovered since the birth of the planet.

Geneva gave the impression of being a market of dreams, but was in reality a very definite international trade fair, at which billions of dollars were ultimately at stake . . . Relaxation of tension . . . if it continues—and why should it not continue?—the fair will be repeated and lead to concrete results. Atoms for peace!

The first sales

The beginning was highly ceremonious. One after the other, distinguished heads of delegations came forward to assure the Conference of their governments' desire to encourage scientific development for the good of mankind. Admiral Lewis L. Strauss, Chairman of the U. S. Atomic Energy Commission; Professor D. V. Skobeltzin, member of the Russian Academy and head of the Physics Institute; Sir John Cockcroft, head of Britain's Atomic Energy Research Establishment; Dr. H. J. Bhabha, Chairman of the Indian Atomic Energy Commission and of the Geneva Conference.

Apart from Admiral Strauss, who is a member of a well-known Wall Street family, all these men are prominent representatives of pure science.

The day before, these same men, accompanied by other scientists and economists, had attended the opening ceremony of the Atoms for Peace Exhibition, held in Geneva's *Palais des Expositions* during the same period as the United Nations Conference at the *Palais des Nations*. All these events were well attended. For example, there were 631 observers authorized by their governments and the United Nations Secretariat to follow the proceedings whenever they felt the urge. Many did feel the urge, and there was no lack of dinners, cocktail parties and similar events to facilitate private contacts. At President Eisenhower's wish these men were to help find a way out of the dilemma created by the atom and prepare the peaceful use of atomic energy. These were the people sarcastically referred to as "vultures" waiting to fall on the work of the scientists. Nothing could have been further from the truth! Such an impression could only result from the most superficial of observations, for Geneva was an entirely serious affair.

Customers were not lacking. The first was the Swiss Government, which had bought for national research purposes the atomic reactor that had been set up in the *Palais des Nations* gardens. Built by the U. S. firm of Union Carbide & Carbon Corporation, it went to Switzerland at half price under the Eisenhower programme, to enable her to study the new "black magic".

To name a second example of commercial interest in the conference: the opening ceremonies of both Exhibition and Conference had been attended by a short, modest-looking man, the centre of a group, whose object in coming to Geneva was known within twenty-four hours: Professor Vittorio Valletta, President of Italy's Fiat works, was the second European purchaser of an atomic reactor, of a model designed by Westinghouse.

The rest of what happened or was discussed at Geneva was either described at length in the world press or was simply not published at all. At any rate, business began in Geneva. A new economic branch had been opened up.

Origins and targets

Some two years have gone by since it was rumoured that Standard Oil Company of New Jersey, the biggest oil producer in the world, was making a detailed study of atomic energy. Observers at first were perplexed. Was Esso preparing to support a competitor to its own oil organization, or did it merely wish to prove that oil would have to remain one of the main sources of energy for a long time to come? It was not long before Standard Oil solved the mystery. Its chief representatives in most countries gave lectures to show that with demand increasing at its present rate even the oilfields would run out one day. Esso was therefore spending huge sums of money on research into the new source of energy that sooner or later must supplement or replace conventional sources. This is one example out of many, but a particularly striking one.

Programme and list of delegates for the International Atomic Conference at the United Nations building, Geneva, and the industrial Atomic Energy Exhibition in the *Palais des Expositions*.

Since then, many private undertakings in the most varied economic and industrial branches, particularly in the United States and Britain, have quietly joined government atomic energy commissions in investigating nuclear energy. Not only large electrical and chemical engineering concerns, but also "outside" undertakings have suddenly entered the new field. "Dutch" Kindelberger, President of North American Aviation Corp.—which has never built anything but aircraft—began several years ago on research and construction of atomic reactors. An indication of the number of interested firms is provided by the Geneva Exhibition catalogue or the list of 176 American firms—admitted by its compilers to be incomplete—published under the title "Atoms and Investors" by the New York brokerage house of Merrill, Lynch, Pierce, Fenner & Beane in spring 1955. And such leading names as Union Carbide and Carbon or United Aircraft are missing from the list, to mention only two. Both have already spent millions of dollars on atomic energy projects.

What, then, had been achieved from the energy point of view, what prospects had forward-looking or clairvoyant industrialists perceived?

For years scientists and economists had been bent over the crystal ball to read in it when the conventional sources of energy were likely to become exhausted. For example, Palmer C. Putnam, an American expert, has made the following calculations in a very interesting book entitled "Energy in the Future", using the ton of coal as a scale for conventional sources of energy (principally coal and oil):

From the beginning of the Christian era up to 1850 some 340,000,000,000 tons of coal had been consumed.

Since 1850 annual consumption has constantly risen, particularly since World War I and the precipitate mechanization of all

economic life. At the present rate, a consumption of at least 400,000,000,000 tons must be reckoned with during the next hundred years. But it can be forecast with certainty that development will increase from year to year.

The whole world reserves of coal and oil are estimated at only 1,026,000,000,000 tons. According to Putnam this reservoir of fossil fuels will be exhausted in fifty years.

To put it bluntly, economic life as we know it would in these conditions be faced by a threat of extinction in fifty years' time . . . unless other sources of energy were discovered and made available before then.

This is one of the reasons which brought more than 600 "observers"—not to mention those who were not listed or who deliberately remained in the background—to the Geneva Atomic Conference in August 1955. The scientist quoted by the French reporter may perhaps have been surprised to see a businessman such as Floyd Odlum on the shores of Lake Geneva. In the literal sense, Odlum is not one of the pure "creative geniuses" whom the United States President wishes to collect together to develop the new source of power. But he has other gifts, including a highly developed flair for promising developments. For a number of years he has been buying up uranium deposits all over the world. He is one of the catalysts in economic life without whom the scientists' achievements would remain pure theory.

Is it likely that hard-headed businessmen would move a finger if the application of the new source of energy were only a matter for the distant future, a problem for later generations? It has been calculated that in twenty or thirty years a kilowatt-hour of atomic energy should be cheaper than a kilowatt-hour from the conventional coal, oil or hydraulic sources. Obviously the initial procurement cost of atomic fuels depends on their quantity. But it is quite legitimate to forecast that before the end of the century atomic reactors will be operating in all corners of the world, not only in under-developed regions which have no coal, oil or hydraulic power, but also in rich industrial countries.

*

These are some of the reasons for the tremendous efforts which Geneva revealed to a wider public for the first time. The ultimate aims are also already recognizable.

In the present issue attention should be limited to the target of greatest immediate concern to aviation, *the atomic power plant for aircraft.*

The "Big Four" catalogues: official publications of the atomic energy authorities of Britain, France, the United States and Russia.

This aspect has a much longer history than many people are aware. Though as recently as a year ago the practical construction of an atomic power plant for aircraft was regarded as a distant target, the situation has decisively changed during the past few months. Nevertheless the late Albert Plesman of K.L.M., one of the pioneers of European air transport, was somewhat over-optimistic when he predicted—from 1950 onwards—that atomic power would be available for aircraft by 1960. Possibly, or even probably, there will be atomic-powered aircraft by 1960, but they will be restricted to a few experimental types for purely military purposes.—The history of these projects—as far as it is known—is outlined below.

1946: The U. S. Army Air Forces awarded Fairchild and other firms research contracts for atomic power plants, under the Nuclear Energy for the Propulsion of Aircraft project.

1950/52: The U. S. Atomic Energy Commission and the now independent U. S. Air Force examined the NEPA documents;

Lockheed announced that it was working on atomic power for aircraft;

Convair and General Electric undertook joint research for atomic-powered aircraft; Boeing and Pratt & Whitney (United Aircraft) joined forces on the same task.

1953: The Defense Department temporarily withdrew support of the NEPA project. However, the Atomic Energy Commission spent roughly $17,000,000 on the project that year and earmarked a similar sum in its 1954 budget.

1954: Establishment of a special research centre, to be operated jointly by the U. S. Air Force and Pratt & Whitney at Hartford, Connecticut, headquarters of United Aircraft Corporation, was announced;

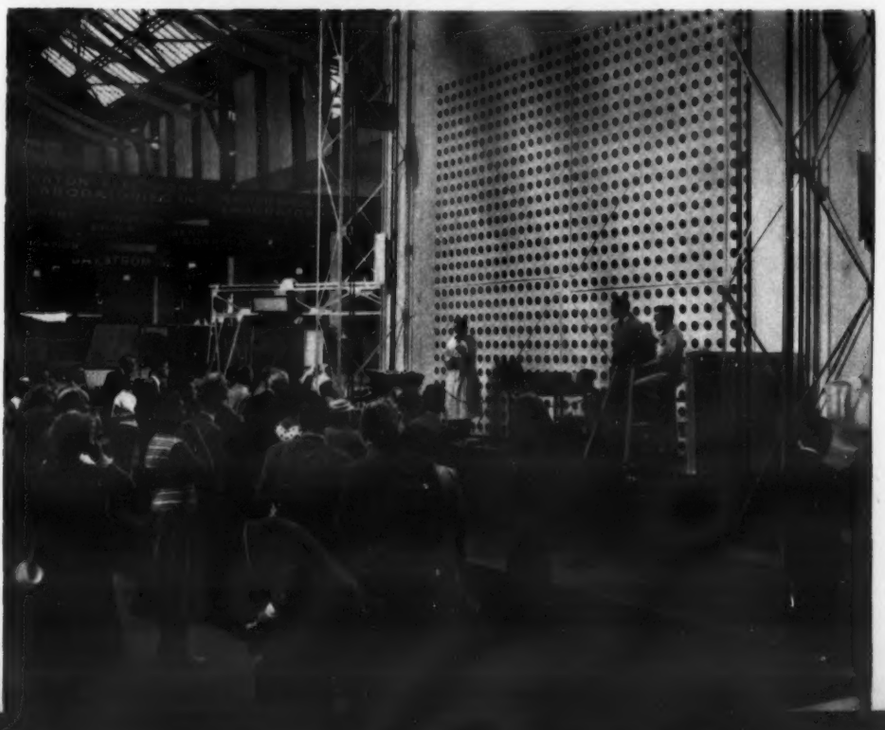
General Dynamics Corporation announced that its Canadian subsidiary, Canadair Ltd., was working on an atomic-powered aircraft.

1955: Britain enters the lists, with leading firms beginning preparatory work;

General Dynamics Corporation expands its interest in atomic power plant for aircraft; the U. S. Atomic Energy Commission suddenly announces that an atomic-powered aircraft could be ready for testing by 1957; Glenn L. Martin, of Baltimore, join up with Union Carbide and Carbon to exploit the latter's experience of atomic reactors, following the example of Boeing/Pratt & Whitney and Convair/General Electric;

Curtiss-Wright follows United Aircraft and Pratt & Whitney in announcing construction of a special plant for atomic aircraft engines; the National Advisory Committee on Aero-

Model of a slow (heterogeneous) atomic reactor for natural uranium and graphite moderators, shown on the United States stand at the Geneva Exhibition *(United Nations picture).*



Dr. Homi J. Bhabha, Secretary to the Indian Government and Chairman of the Indian Atomic Energy Commission, presided over the Geneva Conference on the Peaceful Uses of Atomic Energy *(United Nations picture).*

nautics, top U. S. aeronautical research establishment, gives the problem its official blessing and begins research in its Cleveland laboratories.

In addition, the Atomic Energy Commission is carrying out extensive research at its giant Oakridge installations on radiation shielding and suitable structural materials for an atomic aircraft engine. N.A.C.A.'s Lewis Flight Propulsion Laboratory in Cleveland is extending its researches. The Atomic Energy Commission and the U. S. Air Force have officially announced that the $33,000,000 National Reactor Testing Station at Idaho Falls is nearing completion. The atomic reactor for aircraft is approaching the decisive stage, and three distinct groups of airframe and engine manufacturers are emerging: Convair and General Electric, Boeing and Pratt & Whitney, Lockheed and Curtiss-Wright. Moreover, other firms such as Douglas and Fairchild are not remaining aloof.

What the outcome is likely to be can be judged from the production resources behind these firms and from the Pentagon's open-handedness when some revolutionary innovation appears on the horizon.

The reason for the sudden interest

The tremendous progress of the aircraft industry has brought it up against a third "barrier". First it was the sound barrier that had to be pierced; now the industry is working on the problem of friction heating, and the third obstacle is beginning to appear. With the present means of propulsion airframe and engine designers must choose between high speed and long range. Chemical fuels cannot provide both at once. Only nuclear fuel, i. e., the atomic power plant, can do this.

This problem is interconnected with a political question that has been occupying government agencies in Washington and Moscow, London and Paris since the "Big Four" Conference in Geneva.

Up to this "summit" conference in July 1955 the fear of a surprise attack weighed heavily on staff planners in both camps. Though this danger has not been entirely banished, great efforts are being made to reduce or avert it. Attempts have been made to ward off the danger of surprise air attacks by means of radar warning chains, but the system fails against low-flying aircraft. The Pentagon has tried to stop up this loop-hole by means of *Super Constellations* equipped as flying radar stations (U.S.A.F. designation RC-121 C, U. S. Navy WV-2), but these defences are by no means impenetrable, as it would never be possible to have enough flying radar stations. If there were no developments on the turbine power plants of 1955, the situation would be tolerable, since turbine-powered aircraft are obliged to operate at altitude. But atomic-powered aircraft could cross continents and oceans at low level, and the best of today's radar systems could not detect them.

Thus the atomic engine could conjure up a new strategic danger.

On the other hand it would be an ideal power plant if Eisenhower's proposal for arms control through air reconnaissance were accepted. The range of atomic-powered reconnaissance aircraft would be virtually unlimited. So far, however, the Eisenhower plan remains only on paper.

Military interest in atomic power plants for aircraft is therefore understandable, and it appears very unlikely that the new engine will be available for commercial air transport within the foreseeable future.

Admiral Lewis L. Strauss, Chairman of the U.S. Atomic Energy Commission and leader of the United States delegation to the Geneva Conference.

Two atomic Great Powers in peaceful *tête-à-tête:* (left) the British delegation leader, *Sir John Cockcroft,* head of the Atomic Energy Research Institute at Harwell; (right) Russia's chief delegate, *Professor D. V. Skobeltzin,* member of the Russian Academy of Sciences and head of the Soviet Union's Physics Institute *(United Nations picture).*

Brief technical background

As the present article is addressed not to atomic physicists but to non-scientists interested in aviation, it is necessary to include at least a rough outline of how atomic reactors work. A few technical background data are therefore unavoidable*. As is known, atomic energy was discovered by two German physicists, Professors Otto Hahn and F. Strassmann, who in 1939 succeeded in splitting uranium nuclei and thus releasing quantities of energy unknown up to that time. The basic discovery was soon known to their students and colleagues around the world.

The outbreak of World War II was decisive for the continuation of this research. Time and again there were unconfirmed reports that German scientists had tried in vain to interest their Führer's field marshal genius in the military significance of atomic energy. Hitler went his own way and concentrated on the long-range rockets being developed at Peenemünde.

Meanwhile many European scientists had emigrated. Those who went to the United States included men and women who had attended the birth of atomic energy or had at least followed developments attentively. They brought their American colleagues valuable knowledge. Neither the old story of Einstein's letter to President Roosevelt, which led indirectly to the creation of the first atomic bomb, nor the technical and organizational achievement of atomic physicist Robert Oppenheimer, who actually constructed the bomb, need be recalled here. The energy with which American research took up the whole problem

* The question of atomic energy was discussed in No. 5 1951 by Prof. Friedrich Dessauer under the title "The Production of Energy from Atomic Nuclei" — No. 1, 1955 also contains a brief article on "Atomic Energy, the Power of the Future".

is unmistakably proved by the fact that the first research reactor, an uranium-graphite battery, was taken into operation at West Stands, Chicago as early as December 2nd, 1942. Since then atomic reactors have been built in other countries under the auspices of national atomic energy commissions. Until August 1955, however, the military applications of atomic energy remained in the foreground, so that outsiders were denied knowledge of what went on in these research centres.

It was only gradually that science and industry were able to free themselves from these politico-military trammels. They had long been trying to convince their governments that atomic energy was so revolutionary in significance that it could not be monopolized for ever by a few. At the same time the world's conscience was stirring. To use the greatest scientific discovery of the age—perhaps of all ages—solely for international self-destruction was recognized as monstrous.

All these considerations finally found expression in President Eisenhower's programme as quoted at the beginning of this article. They influenced the conversations between the United States and Russian heads of government on Lake Geneva in July 1955. And scarcely had the "Big Four" flown back to their respective capitals, than scientists and economists gathered in Geneva to prepare the "Atoms for Peace" programme and if possible put it into practice.

By the atom model: *Francis Perrin*, France's High Commissioner for Atomic Energy (left) and *I. I. Rabi*, Chairman of the U.S. Atomic Energy Commission's scientific advisory committee.

For the spectator, the research reactor from Oakridge National Laboratory set up outside the Geneva *Palais des Nations* by the U. S. Atomic Energy Commission and shown in actual operation, was the great sensation. But many other atomic reactors of varying design were shown in model form on the various national stands and discussed during the Conference. *These various reactors—from which the atomic power plant for aircraft must also be derived—may be classified as follows:*

i — *Classification according to speed of chain reaction (or speed of released neutrons in reactor):*

1. slow (or thermal) reactors;
2. fast reactors;
3. semi-fast reactors (at present the most frequent type).

ii — *Classification according to arrangement of fuel and moderator (the latter is used to "brake" the neutrons):*

4. heterogeneous reactors (fuel separate from moderator; both substances in plate or bar form);
5. homogeneous reactors (fuel in solid, soluble or colloidal form mixed with the moderator).

iii — *Classification according to fuel used:*

6. reactors for natural uranium (which contains only about 0.7 % of the fissionable uranium 235 isotope);
7. reactors for "enriched" uranium (up to 20 % U 235, remainder U 238);
8. reactors for plutonium.

iv — *Classification according to moderator used:*

9. reactors with graphite moderator;
10. reactors with heavy or light water;
11. reactors with beryllium or beryllium oxide.

v — *Classification according to purpose:*

12. single-purpose reactors (for slow breakdown of fissionable uranium 235 or 233 isotopes or plutonium 239, without additional production of new atomic fuels);
13. converter reactors (for partial conversion of non-fissionable U 238—about 1 %—into plutonium 239);
14. breeder reactors (for complete conversion of natural uranium 238 or thorium 232 into fissionable elements).

For example, the atomic power plant in the *Nautilus* submarine uses normal "light water" as moderator, while the reactor's fuel elements consist of enriched uranium. The *Nautilus*

The American "swimming pool" reactor, built by Union Carbide & Carbon Corporation and demonstrated in Geneva, works on normal, demineralized water (as moderator) and enriched uranium containing about 20 % of fissionable 235 isotope. The battery of 23 tubular "fuel elements" on the floor of the tank is surrounded by the bluish light produced by the so-called "Cerenkov radiation". Discernible above the battery are the three control rods for the neutron flow, operated automatically by ionization chambers (on either side of the battery).

reactor can thus be classified as a semi-fast (3), heterogeneous (4) reactor for enriched uranium (7) and light water (10) and as a single-purpose reactor (12).

The "swimming-pool" reactor shown at Geneva also works on "light water" (10) and burns enriched uranium (7).

The most promising type of reactor for the next few years is the fast breeder reactor (2 and 14) and the homogeneous reactor (5). The heat exchanger system for reactors up to 75,000 kW power developed by North American Aviation and working on fluid sodium also seems promising.

For *aircraft power plant* the most likely type is the breeder reactor with fast neutrons. This type could probably dispense with moderators and reflectors and thus have minimum dimensions and lower weight. If propellers driven by steam turbines or mercury vapour turbines were used, working temperatures would not need to exceed 600 °C. For turbojet or ramjet engines on the other hand temperatures of over 1,000 °C would be necessary. However, even if the reactor were cooled by fluid sodium or fluid lead-bismuth alloys, it would not be possible to go beyond 1,000 °C, as there are no structural materials for heat exchangers known today that could stand such high temperatures.

Thus an atomic power plant for a heavy propeller-driven aircraft—such as the Convair B-36 intercontinental bomber or the Saro *Princess* flying boat—would weigh some 80 tons (for reactor, drive mechanism and radiation shielding). Jet aircraft would need an atomic engine weighing 125 to 150 tons. This means that atomic-powered aircraft of the future can scarcely weigh less than 200 tons complete.

The atomic reactor set up at the *Palais des Nations* by the United States has been purchased at half price by Switzerland. At the microphone: *Professor Paul Scherrer* of the Federal Institute of Technology, Zurich. Seated in front of him: *Admiral Lewis L. Strauss*, U.S. delegation head, and *Miss Frances Willis*, U.S. Ambassador to Berne.

Transportable atomic reactor (for aircraft ?) built by the Convair Division of General Dynamics, suspended from a crane to measure radiation in the open air.

The advent of atomic-powered aircraft . . . and afterwards

The American industrialist who has been the greatest advocate of the use of atomic energy, including aircraft engines, is a frankly armament industrialist to judge from the structure of the group he heads: he is John Jay Hopkins, President of General Dynamics Corporation.

This group includes the following firms: Canadair Ltd., which is almost entirely concerned with production of military jet aircraft; Electric Boat Division, a shipyard specializing in submarines, which launched the U. S. Navy's first atomic-powered submarines; General Atomic Division, recently formed for research and development of atomic energy installations; Electro Dynamic Division, which resembles the General Atomic Division but with strong leanings towards electronics; Convair Division, the well-known aircraft manufacturers, whose main production, apart from a medium-stage commercial transport, consists of military aircraft of all kinds; and the Stromberg-Carlson Division, another electronics firm.

Hopkins has expanded General Dynamics Corporation to such an extent during the past five years that it is today one of the United States' biggest arms concerns. Its shares have of late commanded considerable attention on the New York stock market. Hopkins has proclaimed himself a champion of the atom and stated not long ago that he was convinced he would live to see the first atomic-powered aircraft fly. The dynamic boss of General Dynamics is now 62 and has given ample proof of his organizing abilities. But he is also a hard-headed businessman and a shrewd calculator. Let it not be thought that an arms industrialist of this calibre is embarking on a speculative venture when he places himself in the vanguard of the "atoms for peace" campaign. Hopkins is quoted as an example not for publicity purposes but as a crown witness for the trend of development that not even a blind man can overlook.

This is the reason for the statement above that 1955 is a historic year. In the summer of 1955 responsible officials from East and West unmistakably told the world that, if used exclusively for war purposes, atomic energy could lead to international suicide. Realizing this, they had met in Geneva to prepare a reduction in tension between the nations. They went one step further and instructed their atomic scientists to confer on the peaceful uses of the new source of power in the same city of Geneva. Previously they had discussed, again with the object of relaxing tension, means of achieving if not immediately a general disarmament at least a limitation of armaments.

These responsible statesmen had known 1918 and the upheaval in Europe, 1929 with the beginning of the world economic crisis and finally 1945 with the downfall of the dictatorships. They and their entourage will have learned their lesson.

A sudden "outbreak of peace", an insufficiently prepared revolution in an economic system based primarily on arms production, would lead to a crisis compared with which 1929 would be child's play. Today a world economic catastrophe on such a scale would be as fatal as a third world war—indeed it might even unleash a third world war.

This raises the most important question of all: how can such a situation be met?

Russia has been promising her peoples peace and prosperity since 1917. The West, led by the United States, is experiencing an economic boom and has only two desires: to maintain high employment and avoid war. Eastern and Western interests thus coincide here.

Yet if West and East arms economy were sensibly throttled back tomorrow, without alternative activity being found for employers and employees, every government would find itself on the brink of chaos.

There is only one "alternative" discernible, to bring the nations new life. There is only one industrial activity sufficiently powerful to preserve the giant industries of West and East that grew up out of World Wars I and II: the exploitation of atomic energy for peaceful purposes—for the peace not only of the underdeveloped, the poor nations, but also to no less an extent of the wealthy nations. *EEH*

The Story of Air Express in the United States

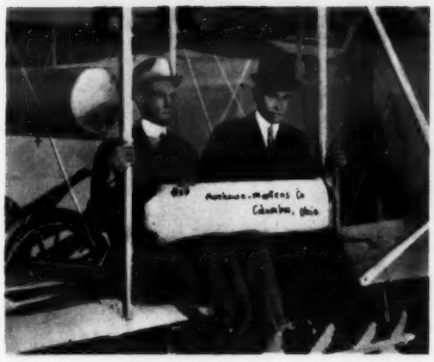
To the shipper in the United States, as well as in Alaska, Hawaii, Cuba and at certain Canadian points, "Air Express" means the fastest way to get something not just somewhere, but virtually anywhere in those areas. It is the fastest link between United States points and international carriers serving the rest of the world.

Air Express, briefly, is one of three basic types of nationwide air shipping service available. These are (1) air parcel post, offered by the U. S. Government for packages not exceeding 70 pounds in weight or 100 inches in length and girth combined; (2) air freight, offered by the scheduled airlines and a small number of scheduled and non-scheduled air cargo operators; and (3) Air Express, a service offered jointly by the Railway Express Agency, which provides the ground handling, and thirty U. S. scheduled airlines, who perform the actual line-haul transportation.

An understanding of how Railway Express operates, perhaps, is necessary to an understanding of Air Express, a division of the railway agency.

As far as surface transportation alone is concerned, the express company offers the coordinated facilities of nearly 500 rail, motor truck and water carriers—a network of 257,000 miles of surface routes connecting the some 15,000 places where there are express offices and the many additional adjacent points they serve.

Owned by 69 major United States railroads, but operating on a contractual basis with all the surface carriers involved, the Express Agency actually competes for traffic in many instances with the services of the individual surface carriers. Express, however, both on the ground and in the air is primarily a package service, offering expedited transportation over a wide geographic area with door-to-door pickup and delivery service at more than 7,000 heavily populated points. Yet, through its many offices and its own fleet of 13,500 vehicles, it offers a fast, coordinated, nationwide service, on a single waybill and with a single-carrier responsibility not otherwise available.



First air express shipment to be made in U.S.A. was flown from Dayton to Columbus, Ohio, November 7, 1910. Photo shows pilot Phil O. Parmalee (right) and unidentified executive of Morehouse-Martens Department Store holding $1,000 package of silk. Sixty-five mile trip took 66 minutes aboard Wright Biplane.

In its air operations, express offers similar features. Although the air freight services of the individual airlines compete vigorously with the Express Agency's surface transportation, their joint efforts through Air Express provide an expedited service important to shippers as well as of material benefit to the participating carriers.

Air Express is carried over the 115,000-mile domestic air network of the 30 scheduled airlines. It links some 1,800 airport cities. Through the Express Agency, Air Express is also linked to the 257,000-mile surface network, making the many thousand off-airline cities and towns logical origination and destination points for air express shipments.

In 1954, for example, 18% of all air express shipments, which accounted for about 21 % of the Air Express Revenue, originated at or were destined to such points on the express surface transportation network.

Air Express is necessarily fast, because it is routed via the fastest connections. Operating twenty-four hours per day, seven days a week, the service is so planned that shipments go out on the *first* scheduled plane flight, regardless of the airline. Some 1,240 planes—making about 10,000 daily flight departures—carry express. After passengers and mail, express has the top priority over all other cargo.

Although Air Express tariffs are filed and published and the charges collected by Railway Express, the rates in the tariffs are prescribed by the airlines.

The growth of Air Express has almost paralleled the development of powered flight.

It was only seven years after the initial flight at Kitty Hawk, North Carolina, that the first experimental air express shipment was made.

On November 7, 1910, a Wright biplane piloted by Philip O. Parmalee took off at Dayton, Ohio, with one passenger and $1,000 worth of silk consigned to the Morehouse-Martens Department Store in Columbus, 65 miles away. The bolt of silk, which had been shipped to Dayton by rail express from New York, weighed 60 pounds and had to be carried on the knees of the pilot and his passenger because the plane had no cockpit, cabin or other cargo-carrying facilities. The historic flight, made in 66 minutes, was considered a stunt—but it did foreshadow the

First full-scale air express experiment took place November 14, 1919, when four-engine Handley Page World War I bomber was scheduled to fly load of parcels from Mitchell Field, Long Island, N. Y., non-stop to Chicago. Plane was forced down at Mt. Jewett, Pa., but shipments completed journey by train.

Scheduled coast-to-coast air express service was inaugurated September 1, 1927, at Hadley Field, New Brunswick, N. J., after four airlines had signed agreements with Railway Express Agency.

realization that the airplane some day would occupy an important place in the operations of commerce and industry.

Following World War I, two British military aviators flew a four-engine Handley-Page bomber from Newfoundland some 1,135 miles non-stop to Mitchell Field, New York. This was a record achievment in 1919 and crystallized an idea. Being favorably impressed, the management of the American Railway Express Company, predecessor to Railway Express Agency, contracted with the aviators to fly a 1,500-pound load of express non-stop from Mitchell Field to Chicago—about 700 miles by air.

Strong headwinds plus some mechanical difficulty cut down the speed of the plane. As a result it was decided to land the bomber at Mt. Jewett, Pa. Fortunately, no one was injured. But the express agent at Mt. Jewett, alerted by the company representative who had been aboard the plane, promptly was on the job. He collected the unexpected air express shipments and forwarded them on the first Chicago-bound passenger train that same evening.

The flight of the Handley-Page represented the first demonstration of coordinated air and rail express service—an even more important feature today.

On September 1, 1927, air express truly was born as an industry when the first commercial airlines began flying air mail and air express simultaneously on regular schedules. This became possible under the provisions of the Kelly Air Mail Act of 1925, which encouraged the formation of the first scheduled airlines by permitting air mail to be carried by private airline contractors.

Four airlines carried air express at the start. They were Colonial Air Transport, operating between Boston and New York; National Air Transport, operating between New York and Chicago and between Chicago and Dallas; Boeing Air Transport, operating between Chicago and San Francisco; and Western Air Express, operating between Salt Lake City and Los Angeles. Total mileage of the first air routes was 4,508 miles.

Air Express begins to establish itself. Shipment of fresh eggs goes to U.S. President Calvin Coolidge at Washington, D.C.

October 20, 1953, first non-stop coast-to-coast air express shipments were unloaded from Lockheed *Super Constellation* at New York Idlewild Airport eight hours after leaving Los Angeles. In 1927 shipments took 33 hours to cover same distance.

In 1928, the first full year of operating, the total number of air express shipments carried was 17,006. In 1954 there were 4,594,162 shipments with a total revenue of $33,248,462. Estimated figures for the first six months of 1955 show 2,427,950 shipments and almost 18 million dollars in gross revenues. It is expected that the revenue for the entire 1955 year will top 38 million dollars.

A question that has been asked very often over the years is "What is shipped by Air Express?" At first, the service was used by many purely for emergency reasons. There is still wide use of air express to meet emergencies. However, it has also become an important part of the distribution system of American business. Nowhere else in the world is production so great and continuous as in America. Nowhere else is competition for business maintained at such a high pitch.

There are many articles of merchandise regularly shipped by air express which are truly perishable, although they are not often classified in that category. Air express compartments carry many shipments of the "wonder drugs", radio isotopes, biologicals, serums, live animals and other items which have either short life or must be carefully protected at all times. They are among the shipments more readily recognized as perishable.

Surprisingly, perhaps, among the "perishable" merchandise carried frequently by air express is women's style apparel. A new hat or dress placed on display a day, or even hours ahead of the competitor's retail store window display is an advantage not to be dismissed lightly. It gets the buyer's attention first and often commands a premium price.

Long gone are the days when the ladies of the smaller cities and towns had to wait days or even weeks before the newest styles arrived for their selection. The residents of the smaller places are dressed nowadays in the latest styles just as soon as their counterparts who live in the fashion centers where the garments are designed and manufactured.

The use of air express by the industrial as well as the retail merchandising field enables wholesalers and retailers to maintain low inventories and achieve a rapid turnover of

In early 1930's some airports were located near railroad lines. Photo shows air express shipments being transferred from train to airplane.

Helicopters were added to Air Express system in 1955 when New York Airways machines began to carry shipments in New York area. Helicopters now also carry air express in Los Angeles district.

their stock. For example, if an out-of-stock automobile part is needed by a customer, the local dealer can telephone or telegraph the manufacturer to send it by air express. Some articles are often sent directly to the customer's home through the special delivery service Railway Express Agency maintains in addition to its special pickup service at origin.

The printing industry as well as publishing and advertising houses utilize air express to meet ever present deadlines. Both the American radio and television industries are large users of air express service. Radio broadcast records and films of leading TV programs, as well as news film are shipped immediately to stations off the networks and delivered within close time schedules to meet program needs.

The machinery and hardware fields have long been users of the air service. Production lines in industry threatened with stoppage because of the shortage of critical materials or because of machinery breakdowns many times have been kept running by the timely arrival of the needed materials or parts. The time and money saved by averting plant tie-ups through the speedy arrival of shipments by air express is incalculable.

After a request for service is received, an express driver is dispatched to the office, plant or residence for the pickup. Two-way radio is used at a growing number of points to further expedite the procedure. At the time of pickup, the shipper is given a receipt and the shipment starts its trip. Usually, air express shipments are taken into one central clearing office in the larger cities where they are sorted according to airline and departure times. Then special trucks speed the shipments to the airport, where they are turned over to the proper airlines for loading and departure toward destination. At the destination airports, Railway Express Agency trucks meet the planes, shipments are accepted from the airline and then transported downtown for prompt delivery. The express driver delivering the shipment secures a signature from the consignee.

As most of America is in a hurry a good part of the time, the partnership of the airplane with industry through the services of air express long has been a close one.

During the last two years helicopters have been added to the air express airline network to further help speed the handling and distribution of shipments at large East and West Coast metropolitan centers. Since late 1953, Los Angeles Airways, Inc., operating out of International Airport, Los Angeles, California, and since November 1954, New York Airways, Inc., operating out of and between New York's three airports, have been expediting air express shipments to dozens of surrounding cities and towns formerly served solely by surface transportation.

In addition, 3,000 new 1½-ton rail and air express pickup and delivery trucks costing some $9½ million have been placed in service during 1955 alone at 69 cities across the nation. These new vehicles and others which will replace the company's entire 13,500-unit fleet will continuously help speed the handling of air express in local pickup and delivery operations and in speeding shipments to and from the nation's airports.

Although air express handles today a smaller percentage of the total volume of goods shipped by air, because of the development of air freight after World War II, it continues to make material gains year after year.

In a thriving and dynamic economy air express undoubtedly will continue to make steady gains, because to the shipper who is concerned with speed and convenience "Air Express" still means the fastest way to get something virtually anywhere.

AIR EXPRESS STATISTICS

Year	No. of Shipments	Gross Revenue (US-Dollar)	Express Ton Miles	Average Mile Haul	Average Pound Weight per Shipment	Airway Mileage
1927 (4 mo.)	5,160	38,176	—	—	—	4,508
1928	17,006	130,774	—	—	—	7,748
1929	12,781	138,402	—	—	—	10,314
1930	11,645	90,146	—	—	—	13,361
1931	9,074	64,708	—	—	—	10,443
1932	24,448	95,348	—	—	5.8	10,867
1933	68,242	217,967	—	—	5.9	13,658
1934	138,308	412,951	—	—	6.3	15,507
1935	200,222	587,077	1,089,802	—	7.7	19,178
1936	465,726	1,339,833	1,860,809	—	8.0	27,844
1937	625,006	1,700,463	2,156,070	—	6.8	36,194
1938	715,410	1,919,875	2,172,855	919	6.6	39,289
1939	890,806	2,385,142	2,705,223	925	6.7	40,767
1940	1,078,189	3,043,231	3,470,056	901	7.1	44,399
1941	1,306,629	4,277,070	5,249,678	934	8.6	47,399
1942	1,405,320	9,036,381	11,736,968	1,081	15.4	45,113
1943	1,543,729	10,999,095	15,158,581	987	19.9	46,422
1944	1,773,823	11,451,164	17,000,658	992	19.3	51,108
1945	2,146,650	13,496,529	20,442,780	1,019	18.7	59,110
1946	3,180,996	14,717,645	23,712,306	882	16.9	66,660
1947	3,758,772	17,552,500	28,641,767	854	17.8	79,112
1948	4,043,215	18,503,926	29,739,183	802	18.3	90,304
1949	3,600,292	17,272,353	27,509,475	772	19.8	90,509
1950	4,230,897	22,901,131	37,262,236	751	23.5	99,342
1951	4,298,640	30,675,272	41,522,814	756	25.6	106,026
1952	4,227,513	32,364,803	41,645,523	784	25.1	109,492
1953	4,424,909	34,238,950	43,938,793	784	25.3	115,019
1954	4,594,162	33,248,462	41,641,209	792	22.9	115,560
1955 (6 mos. estimate)	2,427,950	17,801,147	22,089,481	800	23.4	115,560

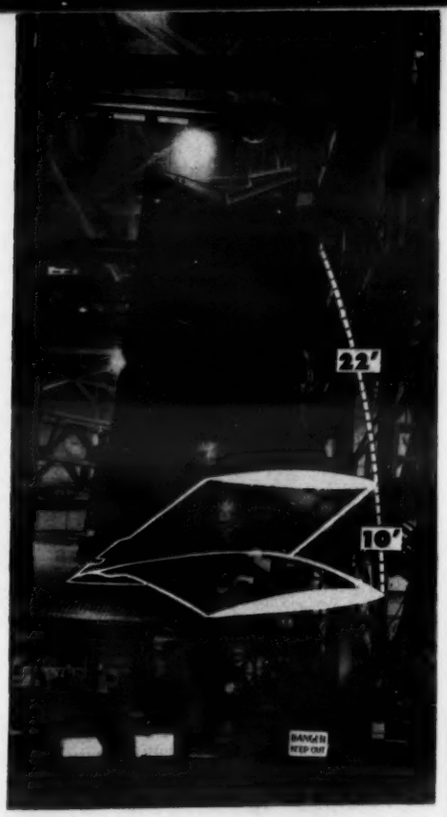
Note: Where figures are not shown, statistics are unavailable.

The B-52 in the Torture Chamber

The most extensive structural proving programme ever applied to a single aircraft is nearing completion. For twelve months the B-52 *Stratofortress* eight-jet long-range bomber has been undergoing searching strength tests at Boeing Airplane Company's main Seattle plant. These have proved that the B-52, newest aircraft type for the U. S. Air Force's Strategic Air Command, not only meets but in most cases exceeds requirements.

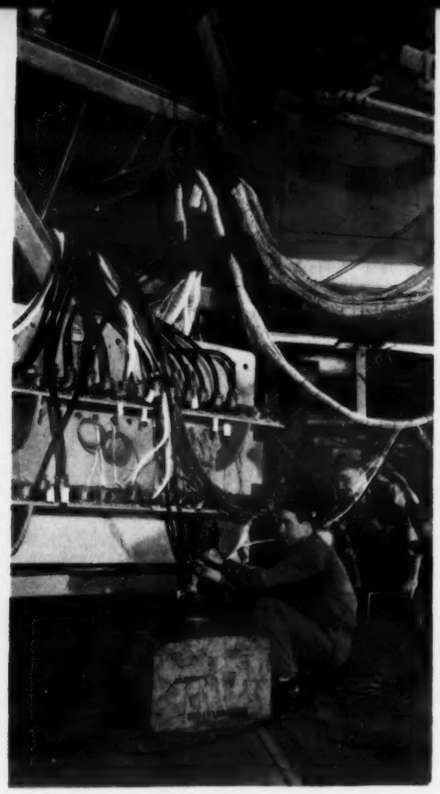
The amount of engineering required for the structural testing of so large a bomber is illustrated by the pictures on these pages. Inch by inch the whole airframe is checked, by means of electrical strain gauges and electronic measuring instruments, until the engineers have determined to within a few pounds just what loads their aircraft can withstand.—As the in-flight stresses and elastic deformations on an airframe of the B-52's dimensions had never been investigated before, new calculating methods had to be evolved before construction work was begun. They were designed to determine what flight loads would arise and how they would be distributed over the airframe. Here use was made of a procedure that had already been successfully applied in the design of the six-jet B-47 *Stratojet* long-range bomber. A so-called "aero-elastic model" of the B-52, with the same elastic behaviour (under the influence of air forces) as the full-scale airframe, was tested in various attitudes and at differing flow speeds in the Seattle wind tunnel. Minute strain gauges distributed over the model (9 ft. in span) measured the forces occurring and the stress distribution.

The data obtained from these tests were used in planning the comprehensive structural



In one of the most important test phases the B-52's 85-ft. wing was stressed beyond the normal maximum load occuring in operation. The wing tips flexed 10 ft. down in negative load condition and 22 ft. upwards in positive load condition.

Static load tests on the B-52 wing: the test loads are applied by more than 50 hydraulically operated jacks, some of them mounted on the concrete floor, others in the upper beams of the test rig. Hydraulic hand pumps on the rows of desks (left) are used for individual control of the loads applied.



Left: Boeing mechanics adjusting a hydraulic jack for applying test loads. Right half of picture shows – between hydraulic jacks and fittings underneath the wing – two "extension brakes" to prevent violent motion in the rest of the airframe when one part ruptures. The brakes are made of alternating layers of sheet steel and bronze assembled into a zig-zag form. Normally compressed, they extend under load and absorb the major part of the kinetic energy released when an airframe component fails. – *Right:* more than 60 miles of instrumentation wiring and nearly 3,000 strain gauge circuits had to be installed before actual tests could begin.

proving programme for the full-size B-52. In particular, they gave useful indications of how the hydraulically applied loads should be distributed in the full-scale tests.

The latter, primarily consisting of static tests on the whole aircraft, were carried out in a 500-ton test rig of unusually high rigidity. More than 60 miles of instrumentation wiring and nearly 3,000 strain gauge circuits had to be installed before the actual tests could begin. More than 50 hydraulic jacks for continuous modification of loads were mounted either on the concrete floor of the test hangar or in the upper beams of the test rig. Each is fed with hydraulic fluid by means of hand pumps, which ensure individual control of each jack.—In one of the last and most important phases of the test programme the 185-ft. wing was stressed past the design maximum load, with the total of static loads reaching roughly 450 tons. During these tests the wing tips flexed 10 ft. down in the negative load condition and 22 ft. upwards in the positive load condition (see picture).

Static load tests on the whole airframe are essential for aircraft of this size, as theoretical stress calculations cannot provide fully reliable data on all load conditions that may arise. Such practical tests may also uncover defects in detail designing which would otherwise not come to light until later—perhaps too late. In addition to the main assembly groups—wing, fuselage, tail unit, engine mountings—some

Applying a moderate positive load to the B-52's right wing. The load distribution arms are connected to fittings arranged on top of the wing for the purpose.

The B-52's right wing is prepared for static load tests. On top of the wing are the load distribution arms which spread the loads transferred via cables from the hydraulic jacks (not shown in picture) to simulate air forces occuring in flight.

3,000 other components were tested for their breaking strength, with special measuring equipment being used to record behaviour under increasing load. Altogether 160 load tests have been made on this particular B-52, which, apart from the fact that engines and some equipment items had been removed, was similar in every respect to the production model.

Static strength tests form only a part—though the most important part—of the test programme for what is so far the biggest military aircraft in the world. Boeing and the U. S. Air Force have been working together since 1952 to get the *Stratofortress* fully combat-ready. Results obtained hitherto appear to confirm that the 12,000,000 engineering hours spent on its development will pay dividends.

West Germany:

From Planning to Execution

(MID-OCTOBER 1955)

Re-armament difficulties

The many plans prepared by the Bonn Defence Ministry over the past years have now reached the point where certain decisions cannot be postponed much longer. The position of the Government agencies concerned with rearmament is not an enviable one. Laws, decrees, basic instructions are piling up, and every file is marked "urgent."

On October 7th the Bundesrat passed the *Besoldungsordnung* (Pay Regulations), so that theoretically there are no further obstacles facing the execution of the Volunteers Law (the 6,000-man programme). As these lines go to print, Parliament is beginning discussion of the *Soldatengesetz* (Soldiers Bill), the draft of which gives the German soldier a number of civil rights that were unknown under either the Kaiser or the Weimar Republic, for example the right to vote.

*

The Bonn Cabinet recently discussed at some length the question of whether a special "Federal Defence Council" should be formed to coordinate defence planning, or whether this task should be entrusted to a "small cabinet." The final outcome was the formation of the "*Small Defence Cabinet*" presided over by the Federal Chancellor and comprising the following ministers: F. J. Strauss (since appointed Minister for Atomic Affairs) and Minister for Economic Coordination F. Blücher, as deputy chairmen; Defence Minister T. Blank; Home Minister G. Schröder; Economics Minister L. Erhard; Finance Minister F. Schäffer; Minister for Agriculture H. Lübke.

As will be seen, no fewer than four ministers responsible for economic questions are included in the Defence Cabinet. Another indication that the Government is fully aware of the importance of economic factors in the rearmament programme is the fact that the long-discussed post of *Under-Secretary of State to the Federal Defence Ministry* has finally been entrusted to *Dr. Josef Rust,* hitherto Ministerial Director and Section Head at the Ministry of Economics. Dr. Rust, like Dr. Carl Gumbel who has been appointed head of the Defence Ministry's Personnel Directorate, is said to enjoy the particular confidence of Federal Chancellor Adenauer. At any rate both officials were personal assistants to the Chancellor at the Federal Chancellery up to their present appointments.

Recent weeks have also seen fresh modifications in the general *organization of the Defence Ministry* designed to concentrate efforts and to strengthen civilian control. In addition to the Military Directorate, there are now five other directorates under civilian heads.

Keeping a little apart from the game of personalities and institutions—inevitable in all periods of reconstruction—the Air Force planners in Bonn are preparing for the creation of German air forces, in close contact with the Western Allies. Colonels Steinhoff, Kuhlmey and Hrabák have been sent to the United States for a whole year to refresh their flying experience and take training courses on modern combat aircraft.

A delayed, but officially approved, result of the demonstration of trainers at Nörvenich in May 1955 is the projected order for (probably 300) Piaggio P.149s, to be built under licence by Focke-Wulf. It is planned to use them primarily as communications aircraft. For Army use, the Do 27 with 260 h.p. Lycoming engine appears to have good chances. No basic trainer has so far been selected, as sufficient equipment of this category is expected to be forthcoming from foreign arms aid sources. Negotiations are also still continuing, with some prospect of success, on orders or licence agreements for France's Fouga CM. 170-R *Magister* jet trainer and the twin-engined Nord 2501 military transport. German planning agencies are also interested in the trainers designed by Professor Messerschmitt in Spain.

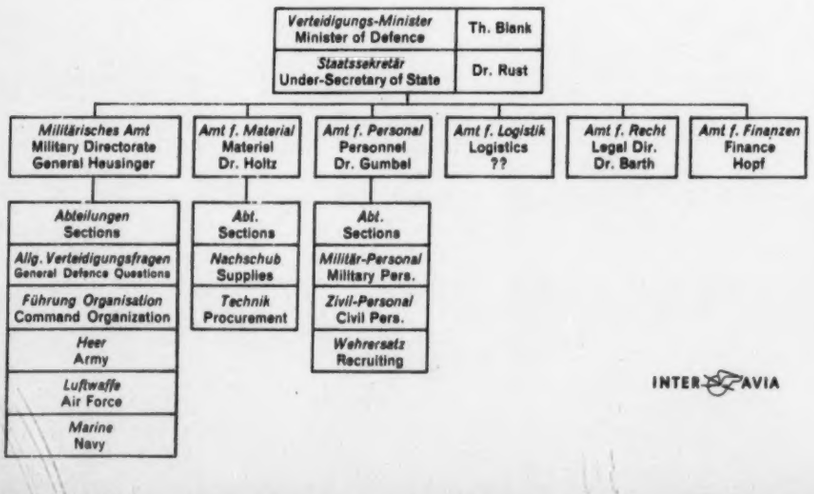
Lufthansa's first General Meeting

The Deutsche Lufthansa held its first General Meeting in Cologne, management headquarters, on October 4th, 1955, under the chairmanship of its President, Dr. Kurt Weigelt. As the new Lufthansa did not begin operations until this year (domestic services on April 1st, 1955, European services on May 15th and trans-Atlantic services on June 1st), both business report and general meeting showed evidence of this "running-in" period. A worthwhile analysis of operating performance and financial results cannot be made until 1956. The management is still concerned with preparatory measures.

These measures include the increase in share capital from DM 50,000,000 to DM 80,000,000 authorized by the General Meeting. The new shares, which have been issued at a par value of DM 1,000 and may draw dividend from January 1st, 1956, can theoretically be taken up by old shareholders at the rate of three new shares per five old ones. However, the Federal Government, as main shareholder, has declared itself prepared to relinquish its new shares to free shareholders from private enterprise. Private investors can take shares up to March 31st, 1956.

The new capital is to be used primarily for the urgently required expansion of the fleet, at present consisting of four Convair 340s, four Lockheed L-1049 *Super Constellations,* three Douglas DC-3s and two Saab *Safir* trainers. Four more *Super Constellations* are on order. It is also planned to purchase "turboprop aircraft".

Organizational diagram of the Bonn Defence Ministry.



Some 300 Piaggio P. 149 four-seat military communications aircraft are to be built under licence by Focke-Wulf (engine: 245 h. p. Lycoming GO-435).

The funds provided by the agreed increase in capital will not be sufficient to finance these plans and expand the airline's ground organization in Europe and overseas. The Lufthansa's management estimates that total investments of DM 136,000,000 will be needed by mid-1956, including DM 82,800,000 for aircraft, DM 31,600,000 for spares, DM 10,200,000 for workshops, airport stations and administrative buildings, DM 11,400,000 for working capital. These funds are to be raised as follows: DM 50,000,000 from share capital, DM 15,000,000 from a Federal Post Office loan, DM 25,600,000 from Federal funds, DM 45,400,000 from depreciation (reserve).

As regards the Lufthansa's past operating experience, President Dr. Kurt Weigelt and Board member Hans M. Bongers both stated that the beginning was difficult but promising. This should be remembered when assessing the 1954 accounts. Aircraft load factor had been 60% on European services and around 45% on North Atlantic operations. This was due to initial problems and the shortage of capital and flying equipment. After delivery of the four additional *Super Constellations,* scheduled for the spring and summer of 1956, long-distance services are to be expanded, primarily to South America and the Middle East, and North Atlantic services practically doubled. No additional routes are planned in Europe.

Besides shortage of aircraft, the company is also suffering from a shortage of personnel, particularly of flying crews.

On this subject Board Member Dipl.-Ing. Gerhard Höltje said that so far 123 pilots from among members of the old Lufthansa and former Luftwaffe had been trained and were now acting as co-pilots. As the fleet is expanded the need for captains will obviously increase, so that not only will the eleven foreign captains already employed have to be retained, but another fifteen foreigners engaged for a time. Hitherto 48 flight engineers had been trained, and 19 young engineers engaged. The problem of technical personnel was almost as serious as that of aircrews.

Three main problems have therefore come to the fore in the growth of the new Deutsche Lufthansa: capital, aircraft, and flying and technical personnel.

As regards route authorizations, Lufthansa can be very pleased with the air transport agreements so far concluded by the Federal Government. The unusually favourable agreement with the United States and the Anglo-German agreement have already been discussed in these pages. They were followed on October 4th, 1955, by signature of a Franco-German air transport agreement which gives Lufthansa landing rights in France on routes to Spain and Portugal, North and South America. In exchange Air France may call at German cities on its services to Southeast Asia and the Near and Far East. The pre-war close collaboration between Air France and Deutsche Lufthansa thus appears to have been revived on an even more extensive basis, as the two companies are not only to operate South American services in pool, but have also reached agreement on the North Atlantic and South Africa.

Messerschmitt-Hispano Aviación HA.200 R-1 jet trainer (two Turboméca *Marborés* in the floor of the fuselage), for which a German "experimental contract" has been awarded.

Scientific Conferences in Munich and Augsburg; aircraft display at Oberwiesenfeld

The interest which other countries are showing in aeronautical research and development in West Germany is illustrated by the number of delegates they send to scientific conferences. For example, speakers at the Deutsche Versuchsanstalt für Luftfahrt (German Aeronautical Experimental Institute) Meeting in Munich (September 29th to October 1st, 1955) included Dr. H. L. Dryden (Director of N.A.C.A.) and Dr. K. Oswatitsch (Stockholm Institute of Technology). At the Augsburg WGL Conference (Wissenschaftliche Gesellschaft für Luftfahrt = Society for the Aeronautical Sciences; October 12th to 15th, 1955) papers were read by J. L. Anast (U.S. Air Force, Washington), E. S. Calvert (R.A.E., Farnborough), W. P. Lear (President, Lear Inc.), Dr. W. Jacobs (Stockholm-Ulvsunda), Prof. J. T. Lacour (University of Geneva) etc.

During the DVL Meeting an aircraft display was organized at Oberwiesenfeld, Munich's sports airfield, on October 1st. In addition to a number of sailplanes (single and two-seat models), the following new German powered aircraft types were shown:

- Dornier Do 27
- Winter *Zaunkönig*
- Scheibe *Sperling*
- Dittmar *Möve*
- Pützer *Moraab*
- Fischer RW-3

Non-German aircraft on view were the Nord 1203 *Norécrin,* Jodel *Bébé* and Jodel *Club* (all French), Pasotti *Airone* and Piaggio P. 148 (from Italy).

Among the German powered aircraft only the Dornier Do 27 is of interest for military use. In view of the growing needs for the German armed services now being formed, however, further military types, now under development, may be expected to appear at future air displays.

AIR DISPLAY AT MUNICH/OBERWIESENFELD

(OCTOBER 1st, 1955)

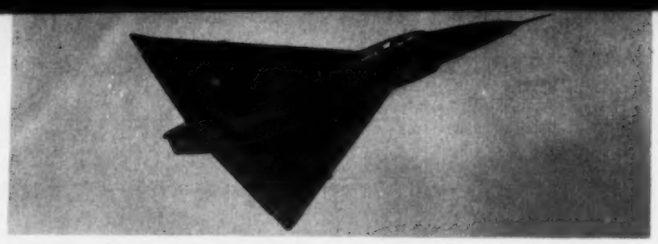
Dornier Do 27 military communications aircraft (with Spanish markings; 225 h. p. Continental engine) flying at low speed over a Bücker Jungmann tug aircraft (with Swedish number and "Royal Bavarian" markings on the rudder unit).

The *Zaunkönig* single-seat "foolproof" elementary trainer (51 h. p. Zündapp engine) built by Professor H. Winter of Brunswick.

Dittmar HD. 153 *Motor-Möve* sports two-seater (95 h. p. Continental engine).

Pützer *Moraab* sports two-seater (30 h. p. Volkswagen engine).

Admired – but not demonstrated in flight: the Fischer RW-3 all-metal sports two-seater with 50 h. p. Porsche automobile engine, propeller in tail, retractable undercarriage (. . . but so far no pressure cabin).



Convair F-102A delta-wing fighter, production model (above), and McDonnell F-101A *Voodoo* escort fighter, production model.

Douglas A3D-1 twin-jet naval bomber.

U. S. National Aircraft Show 1955

The 1955 U.S. National Aircraft Show, which took place at Philadelphia International Airport on September 3rd, 4th and 5th, attracted about 290,000 spectators—roughly the same attendance as at the British S.B.A.C. Display from September 5th to 11th. But while the latter is distinctly an export fair, the Philadelphia Show was primarily designed to demonstrate to the average citizen what the Defense Department is doing with his tax money. Accordingly, few of the roughly 50 aircraft types on the ground or in the air were of the very latest type, nor did the civil transport manufacturers make any great effort to show off their latest products. Highlights of the Show were the announcement that on August 20th Col. Horace A. Hanes, USAF, had set a speed record of 822.135 m.p.h. in a North American F-100C *Super Sabre* flying over an 11-mile course, as well as such traditional events as the Bendix Trophy Race, the General Electric Trophy race, and the Allison Event—the last a non-flying contest involving the fastest engine change on a Lockheed T-33 trainer. — Some of the newest aircraft on show at Philadelphia are illustrated below.

Lockheed C-130A *Hercules* turboprop heavy transport.

North American F-100C *Super Sabre* tactical fighter which, flown by Col. Talbott, won Bendix Trophy Race.

Douglas A4D-1 *Skyhawk* multi-purpose naval attack aircraft, tenth machine to be produced.

Douglas EB-26C experimental aircraft with missile guidance nose.

North American FJ-4 *Fury* naval interceptor.

Sikorsky XHR2S-1 assault helicopter of Marine Corps.

Piasecki YH-16A helicopter with two T-38 turbines exhausting under front and in ta of fuselage.

What's in the Air ? *

AIR TRANSPORTATION

● I.A.T.A. woos Russia

At the opening of I.A.T.A.'s 11th Annual General Meeting (Tenth Anniversary General Meeting) both retiring I.A.T.A. President Max Hymans (1954-55) and new President Juan T. Trippe (1955-56) suggested that the Russian airline *Aeroflot* should join in I.A.T.A.'s deliberations as soon as possible. It was a regrettable fact that one sixth of the inhabited earth should remain closed to world air transport. Just as the Eastern *bloc* is represented in the United Nations, so this enormous territory should have a voice in the organization of international air networks.

● P.A.A. orders 45 jet airliners

In mid-October Pan American World Airways made the sensational announcement that it had ordered no fewer than 45 four-engined jet transports at a total cost of $269,000,000. The surprise caused by what is the biggest procurement programme in air transport history became even greater when it was learned that the order was divided between the two U.S. jet airliners now in development : deliveries of 25 Douglas DC-8s at a price of more than $160,000,000 (with spares) are to begin in December 1959 ; 20 Boeing 707 costing roughly $109,000,000 are to be delivered between December 1958 and November 1959. The reasons for this division of orders are probably several : thanks to the relatively early delivery dates for the Boeing 707, P.A.A. should be able to introduce jet services at the same time as British Overseas Airways, which will not receive its first D.H. *Comet IVs* before the end of 1958. In connection with the P.A.A. order, Douglas announced that the aircraft in question would have more powerful engines than the Pratt & Whitney J-57s originally planned for the DC-8 (P&W J-75?).

● A billion 3-cent letters go by air

The U.S. Post Office Department reports that nearly a billion letters a year are being delivered with greater speed—as much as 48 hours saving in many instances—under the experiment of carrying all first-class mail by air when space is available. At present 24 airlines serving some 200 cities in 33 States participate in the scheme.

● Air transport still modest

The Chief Executive of British European Airways has stated that all branches of transport in Britain now employ a total of 1,345,000 persons. Air transport's share in the total is only 30,000.

● Vanguard to follow Viscount

British European Airways has confirmed that it is negotiating with Vickers-Armstrongs for the supply of a fleet of Vickers V.900 *Vanguard* turboprop transports (95 to 105 passengers), for delivery in 1959-60. Fitted with four Rolls-Royce RB.109 *Tyne* turboprops, the *Vanguard* is to be used on high-density medium stages.

AVIATION POLITICS

● N.A.T.O. statements on European air defence

During the Paris meeting of the N.A.T.O. Council of Ministers leading military officers expressed considerable concern over the present state of European air defence. General Alfred M. Gruenther, Supreme Commander, Allied Forces, Europe, spoke of an " *antediluvian organization* " of the air defence command and demanded early coordination and division into four regional commands (North, Centre, Mediterranean/South, United Kingdom) ; immediate equipment with modern radar.—Field Marshal Viscount Montgomery, Deputy Supreme Commander, Allied Forces, Europe, went even further. In his opinion it is essential that all European air forces be merged into a single force. This force should be placed under an American commander, as the United States is the only N.A.T.O. power with a strategic bomber fleet.

Lieutenant-Colonel Gerben Sonderman, head of Fokker's flight test department and personal pilot to the Dutch Royal family, was killed in an accident on October 20th, 1955 when demonstrating the Fokker S.14*Mach Trainer* at Hagerstown, Maryland.

With orders in his pocket ... Donald W. Douglas with the model of the Douglas DC-8 jet transport, for which Pan American World Airways has placed an order for 25 and United Air Lines for 30.

● German Atomic Minister

Franz-Josef Strauss, hitherto Minister without Portfolio in Adenauer's Cabinet, who recently was appointed deputy chairman of the so-called " Small Defence Cabinet ", has also been made Minister for Atomic Affairs.

● East German-Russian air agreement

On October 18th the Soviet Union and the East German Democratic Republic concluded an agreement in Moscow on technical cooperation in civil aviation and the establishment of air transport relations. Russia was represented in the talks by members of the Directorate General of Russian Civil Aviation and the Aeroflot management, East Germany by officials from the East German airline now being formed.

SERVICE AVIATION

● All-European radar chain

During his visit to Europe for the N.A.T.O. ministers' meeting in Paris, U.S. Defense Secretary Charles E. Wilson called for a unified aircraft warning radar chain on the model of the U.S.-Canadian Distant Early Warning system.

● Bréguet Deux Ponts for French Air Force

It is officially announced that Société des Avions Bréguet is to supply 23 *Deux Ponts* transports for two transport units to be formed in the French Air Force.

● Atom-powered aircraft carrier for U.S. Navy

According to unconfirmed reports from Washington, the U.S. Navy plans to lay down its first atomic-powered aircraft carrier not later than 1957. The National Reactor Testing Station in Idaho is believed to be working on the prototype of a large ship reactor, similar to that used in the submarine *Nautilus*, to be fitted in the sixth or seventh *Forrestal*-class carrier.

● U.S. Air Force gives way to birds

According to a report in the London " Times ", the U.S. Air Force has abandoned its plans to expand its bombing and gunnery range at Matagordo, Texas, in deference to opposition from the Canadian Government and other interested bodies who wish to preserve the wintering grounds of the whooping crane, only two dozen specimens of which are known to exist.

INDUSTRY

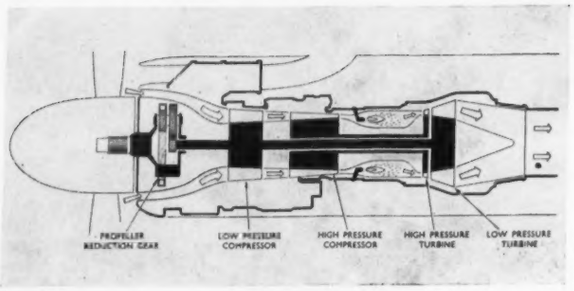
● Sir Frank Whittle to leave Europe

Sir Frank Whittle, pioneer of jet propulsion and designer of the first British jet engine (the W1 for the Gloster E.28/39), has given up his residence in England and gone to the United States to work on a secret project for Royal Shell, to whom he acts as technical adviser.

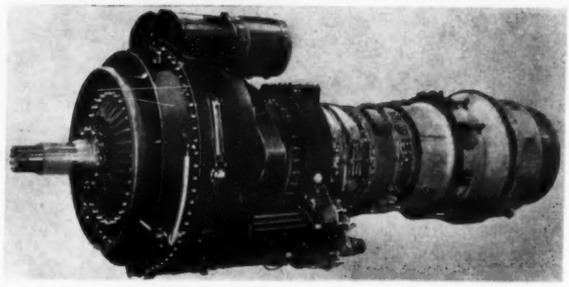
● Billion dollar orders for the U.S. Air Force

During recent weeks the U.S. Air Force has placed orders for more than $1,000,000,000 worth of new aircraft (bombers, fighters, transports). Included in the total are orders to Lockheed for $100,000,000 worth of F-104A fighters and $100,000,000 worth of C-130A *Hercules* transports, to McDonnell for three versions of the F-101 *Voodoo* all-weather fighter valued at $360,000,000, and to Convair for roughly $390,000,000 worth of F-102 delta-wing all-weather fighters, the later versions of which are to be fitted with P&W J-75 engines.

* Extracts from *Interavia Air Letter*, daily internationa news digest, in French and English. All rights reserved.



Rolls-Royce RB.109 *Tyne* turboprop of 4,470 e.h.p., which is to power the Vickers *Vanguard* medium-stage aircraft.



Model of the Vickers V.900 *Vanguard* (foreground) which will be ready for delivery in 1959-60, compared with the smaller Viscount 800.

● France gets higher research credits for military aircraft

Research funds for military prototypes granted under the French budget are to be raised from 28,000,000,000 francs in 1955 to 32,000,000,000 francs in 1956.

● Kawasaki assembling T-33

Kawasaki, of Kobe, Japan, has begun assembly of the first Lockheed T-33 jet trainers from parts and engines supplied by the United States. A total of 97 of these aircraft are to be assembled for the Japanese Air Force.

FLYING EQUIPMENT

● Flight testing of the *Martin XP6M-1 SeaMaster* four-jet combat flying boat is continuing satisfactorily according to schedule, say the manufacturers. Since the first flight on July 14th, 1955, the *SeaMaster* has completed more than 25 flying hours; all tests have been made over Chesapeake Bay, near Baltimore. The flying boat, fitted with four Allison J-71 turbojets of 10,000 lbs. thrust each, is designed for an average cruising altitude of 40,000 ft. and can carry a payload on tactical operations of roughly 30,000 lbs. Span 100 ft., length 134 ft., wing area 1,900 sq.ft., hull beam 10 ft.

● An undisclosed number of *Convair TF-102A* jet trainers has recently been taken from Convair's San Diego plant to Lindbergh Field, where they are making an extensive series of demonstration flights. The two-seat trainer has side-by-side seats and is designed primarily to familiarize pilots with the " hundred " series of jet fighters (F-100, F-101, F-102, etc.). The TF-102A can also be used as tactical interceptor, in which case either pilot can fly it from his own side.

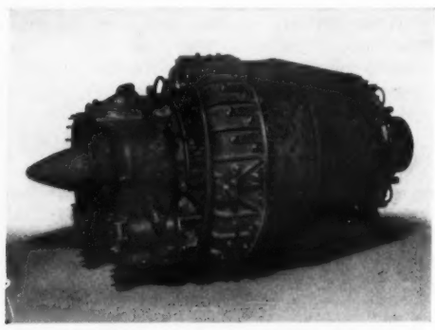
● It is belatedly announced that the *McDonnell XV-1* convertible aircraft has reached a level speed of more than 180 m.p.h. during tests. Although undercarriage struts and rotor support were left uncovered, the full engine power was not required for this speed.

● According to American sources, two *interceptors with mixed propulsion* are under development in Britain and will shortly begin flight testing. One is a Saunders-Roe design and is said to have a delta wing, while the other comes from the A.V. Roe stable. The D.H. *Gyron* (or *Gyron Junior*) turbojet and the *Spectre* rocket motor are mentioned as possible power plant.

POWER PLANT

● At the Turin Engineering Show Fiat showed a turbojet of its own design for the first time : designation *Fiat 4002* ; static thrust 550 lbs. at 26,000 r.p.m. The engine has a radial compressor, single-stage turbine and annular combustion chamber, in which the air flow is twice diverted through 180°. This arrangement enables the length of the engine to be kept low and provides easy access to fuel injection nozzles and combustion chamber. Dry weight is 219 lbs., specific fuel consumption 1.15 lbs./lb./hr.

Snapshot of the Munich Meeting of the Deutsche Versuchsanstalt für Luftfahrt. — Dr. H. L. Dryden, head of the National Advisory Committee for Aeronautics (bending forwards, left) in conversation with Professor A. W. Quick and other members of the DVL Committee.



Fiat 4002 turbojet engine with radial compressor; static thrust 550 lbs.

● *Westinghouse PD-33* is the designation of a new turbojet of 6,000 lbs. static thrust developed by the U.S. firm as a private venture. First test runs are scheduled for spring 1956.

● Flight testing of the *Rolls-Royce RB.109 Tyne* turboprop will probably begin early in 1956, in an Avro *Lincoln*. The engine, which weighs only 1,800 lbs., delivers a shaft power of 4,020 h.p. on take-off plus a residual thrust of 1,175 lbs. (4,470 e.h.p.). Use of separate high and low pressure compressors, driven by two independent turbines, enables the unusually high compression ratio of 12 : 1 to be obtained, so that specific fuel consumption is only 0.414 lbs/hr/e.h.p. The low fuel consumption together with the high power-weight ratio are obtained in part by raising the flame temperature ; operating time between overhauls, however, has not been reduced.

Convair TF-102A jet trainer (left) and Convair F-102A Interceptor.

The Revision of the Warsaw Convention

I. C. A. O.'s The Hague Conference (September 6th to 28th, 1955)

BY PROFESSOR ALEX MEYER,
HEAD OF THE AIR LAW INSTITUTE, UNIVERSITY OF COLOGNE

For the past quarter-century the Warsaw Convention (Convention of October 12th, 1929 " for the Unification of Certain Rules relating to International Carriage by Air ") has been the basis for legal relations between air carriers and their clients (passengers and freight consignors). It is understandable that certain provisions of this Convention should now be out-dated, in particular the articles defining the carrier's liability for the passengers and goods entrusted to him. After lengthy preparatory work, the I.C.A.O. Conference meeting in The Hague in September 1955 agreed on a revision of the Warsaw Convention, which is discussed in the following article by Professor Alex Meyer, internationally known air law expert.

Editors.

The move to revise the Warsaw Convention began in 1935. Originally the problem was handled by the *Comité International Technique d'Experts Juridiques Aériens* (abbreviated " Citeja "). In 1947 the latter's competencies were passed to the International Civil Aviation Organization's Legal Committee, which discussed plans for revision at its meetings in Geneva (1948), Lisbon (1948), Montreal (1948), Madrid (1951) and Rio de Janeiro (1953). At nearly all of these meetings Major K. M. Beaumont, the English air law expert and Chairman of the Legal Committee, submitted a new draft, each differing from earlier projects. In Madrid in 1951 a sub-committee was formed, which worked out yet another draft in Paris in 1952.

Up to the Rio Conference all drafts had aimed at a *complete revision* of the old Convention. Gradually, however, opposition to a total revision hardened. The International Air Transport Association and the International Chamber of Commerce even pronounced against any form of revision, citing the following main reasons: the Warsaw Convention was one of the best international agreements; having been recognized by a large number of countries, it is of general validity and has been incorporated in several countries' air legislation. Moreover, none of the drafts submitted were satisfactory.

The draft prepared by the I.C.A.O. Legal Committee at Rio (August-September, 1953) was the first to restrict itself to an *additional protocol to the Warsaw Convention*, with clearly defined amendments which the Legal Committee considered necessary for practical reasons.

The I.C.A.O. Conference which met in The Hague's Peace Palace from September 6th to 28th was attended by representatives of 44 signatory countries of the Warsaw Convention, including Russia and other Eastern *bloc* countries. The West German Federal Republic, having regained its air sovereignty, was also represented for the first time at an I.C.A.O.-sponsored inter-governmental conference.

The Conference was presided over by *Dr. D. Goedhuis*, Professor at the University of Leyden and Commercial Air Attaché to the Netherlands Embassy in London, who is well known for his writings on air law and in particular on the Warsaw Convention.

Delegates agreed to draw up an *additional protocol* to the Warsaw Convention, which was then signed by 26 States. Certain countries, including the United States and Britain, were unable to sign for purely formal reasons. The protocol comes into force as soon as it has been ratified by at least 30 States. The high number of ratifications demanded is designed to ensure the greatest possible uniformity in the application of the new regulations. On the other hand, it may considerably delay their entry into force. The protocol is drafted in English, French and Spanish, the French text serving as criterion in cases of doubt.

The *final communiqué* of the Conference, signed by 36 States, contains recommendations on the following points: transferability (negotiability) of the air waybill, compulsory passenger insurance, enforcement of verdicts, chartering of aircraft, uniform drafting of international agreements under civil air law.

The following are the three most important amendments agreed upon at The Hague:

1. To meet a wide-spread desire the details to be included in documents of carriage (passenger tickets, baggage checks, cargo waybills) were *simplified* and the liability for missing details consequently reduced.

2. The maximum *liability limit* for personal injury was raised from 125,000 Poincaré gold francs ($8,291) to 250,000 gold francs ($16,582) per passenger, to meet modern conditions.

3. There was lively discussion around the definition of cases in which through the *fault of the air carrier*, his servants or his agents, the limits of liability shall not apply so that he shall be required to bear *unlimited liability*.

Under Article 25 of the old Warsaw Convention the carrier bears unlimited liability if the damage is caused by his

" wilful misconduct or by such default on his part as, in accordance with the law of the Court seised of the case, is considered to be equivalent to wilful misconduct."

At its meeting in Rio the I.C.A.O. Legal Committee proposed the following draft:

The limits of liability shall not apply,

" if it is proved that the damage resulted from a deliberate act or omission of the carrier, his servants or agents, done with intent to cause damage; provided that, in the case of a deliberate act or omission of a servant or agent, it is also proved that he was acting in the course of his employment."

This proposal was rejected by the Conference. Several delegations pointed out, with reason, that if the Rio draft were accepted cases of unlimited liability of an air carrier would be practically non-existant. For the user of air transport it would normally be impossible to prove that " the damage resulted from a deliberate act or omission of the carrier done with intent to cause damage." Several countries also declared that it would be an affront to their peoples' legal sense if liability were not deemed to be unlimited in cases of wilful misconduct or gross negligence.

The Conference decided by 23 votes to 16, with one abstention, to redraft Article 25 as follows:

" The limits of liability specified in Article 22 of the Convention shall not apply if it is proved that the damage resulted from an act or omission of the carrier, his servants or agents, done with intent to cause damage or recklessly, and with knowledge that damage would probably result; provided that, in the case of such act or omission of a servant or agent, it is also proved that he was acting within the scope of his employment."

On the whole the result of the Conference can be described as satisfactory, as it considers the interests of both the air carrier and his clients, in accordance with the aims of the original Warsaw Convention.

Richard's Cyclogyros

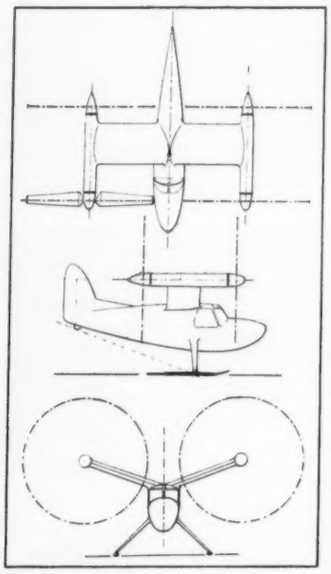


Fig. 1: Richard project for a four-rotor cyclogyro resembling a gyrodyne.

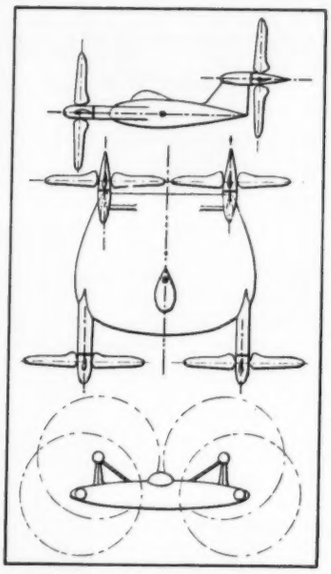
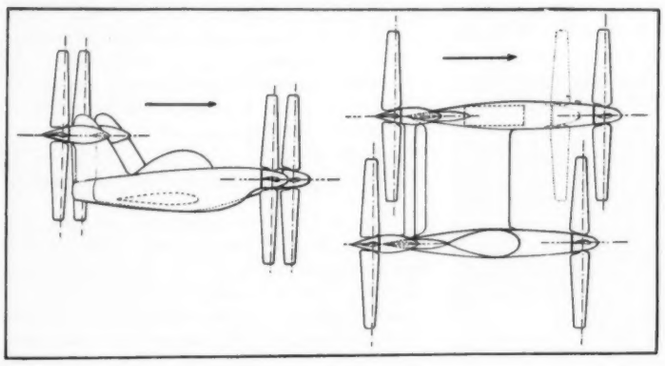


Fig. 2: Project for a four-rotor cyclogyro of " flying pancake " configuration.

Fig. 3: Project for a twin-fuselage, four-rotor cyclogyro. All Richard's cyclogyro projects incorporate a cyclic and collective pitch control system for the rotor blades.



The magazine " Aéro-France " published two articles in its issues for November and December 1954 on the " cyclogyros " designed by the French engineer G.C. Richard, in which the inventor describes three practical applications of his basic principle. These are based on the results of tests he was able to make in the large Chalais Meudon wind tunnel, using a full-scale 13-ft. experimental rotor.

The first project (*fig. 1*) represents a machine that is not too far removed from other types of gyrodyne. This is the design used as an example of a cyclogyro by Professor Gabrielli in an *Interavia* article.[1] This version of the cyclogyro would appear to present no great technical difficulties.

The next two diagrams show much more revolutionary designs. *Fig. 2* is an adaptation of the American " flying pancake " (Chance Vought XF5U-1 *Skimmer* of 1946). As is known, the *Skimmer* encountered considerable difficulties in regard to longitudinal stability at high angles of attack, i.e., in slow flight, and the project had to be abandoned. Richard's experiments have led him to believe that the oblique position of the " flying pancake's " large relatively slow propeller in the low speed condition necessitates cyclic pitch control, which would also produce a substantial lift component. He therefore included in his design, above the vertical fins at the rear of the wing, two other rotors which would give a nose-heavy moment at large angles of attack to counteract the forward propellers' tail-heavy moment. The " flying pancake " thus modified needs no elevators or stabilizing surfaces, as the controllable pitch of the four rotors suffices to ensure manoeuvrability.

The last project (*fig. 3*) appears even more strange at first glance. It is a twin-fuselage single-seater, with the engine in one fuselage and the pilot in the other. The two fuselages are staggered in the direction of flight ; the rotor discs overlap, thus avoiding the difficulties of intermeshing blades. The two fuselages are joined by a short wing. The broken line illustrates an alternative version with shorter engine fuselage.

In all these projects each rotor has a cyclic pitch control ; hence suitable pitch regulation of the individual rotors provides efficient controllability of the whole aircraft. — Although none of Richard's designs have been tested in flight, they appear to be worthy of continued development.

[1] Cf. *Interavia* No. 1, 1954 " The Nature of the Beast " (p. 19 etc.)

Book Reviews

Gas Turbines and Jet Propulsion (Sixth Edition).—G. Geoffrey Smith, revised and enlarged by F. C. Sheffield.—Published for " Flight " by Iliffe & Sons Ltd., London, 1955 (English, 412 pages, price 35 shillings).

After Geoffrey Smith's death in 1951, F. C. Sheffield, an associate of the author's for many years, took over the revision of this indispensable book on modern power plants. The latest edition, now published, has been considerably enlarged by comparison with the 1950 Fifth Edition and brought up to date. Detailed chapters on metallurgical problems, rotating wing propulsion and non-aviation uses of turbines are also included.—Because of their value as aircraft power plants gas turbines were developed to a high level of efficiency within a very short time. It is therefore not surprising that they should also be used to an increasing extent for land vehicles and ships, so that detailed discussion of these applications (in Chapter 17) is fully justified. Nevertheless the editor has eminently succeeded in combining such varied subjects as gas turbine design and jet propulsion into a volume of manageable size which should find a place on every technical bookshelf. Re.

Aluminium-Taschenbuch (11th Edition).—Issued by the Aluminium-Zentrale e.V.—Aluminium-Verlag G.m.b.H., Düsseldorf,1955 (German, 965 pages).

This handbook, first published in 1933 and well-known in both German and foreign industrial circles, has now been issued in its second post-war edition. Its volume has increased to nearly 1,000 pages, and certain gaps, in particular on international development, have been filled. The two chapters on structural principles have been basically revised to meet modern engineering and ship-building requirements, and an appendix of revised German standards is included. A detailed subject index, coupled with a decimal reference system enables any required section to be found immediately.—A welcome reference work that provides exhaustive answers to questions on qualities, applications and treatment of aluminium and its alloys. Re.

British Plastics Year Book 1955.—Iliffe & Sons Ltd., London, 1955 (English, 652 pages, price 30 shillings).

This well-known year book, which has become an indispensable reference work for the British plastics industry, has now been published for the 25th time.—The introductory chapter describes in brief note form nearly 1,000 new patents in all fields of plastics chemistry. Other chapters list manufacturers, classified according to the raw materials used and according to finished products, as well as addresses of all firms, organizations and personalities in the British plastics industry etc. A special section is devoted to explanation of abbreviations, trade names and technical expressions. Finally there is an appendix of technical tables. Re.

Bericht über den V. Internationalen Astronautischen Kongress. (Innsbruck, August 5th to 7th, 1954).—Edited by Friedrich Hecht for the Austrian Space Travel Society.—Springer-Verlag. Vienna-Innsbruck (in the original language of the papers, i.e., German, English, French or Italian ; 307 pages, 165 illustrations, price $13.80, for I.A.F. members $11.05).

With contributions from Oberth, Mrs. Sänger-Bredt, Sänger, Zaehringer, Ehricke and 30 other authors of international fame, and an introduction by Wernher von Braun, this collection of all the papers read at the Innsbruck space travel congress in August 1954 is a veritable mine of information for the space travel enthusiast with some previous scientific training. Papers include the original reports by K. A. Ehricke (Analysis of Orbital Systems) and E. Stuhlinger (Electrical Space Ship Propulsion), discussed in extract form in *Interavia's* last space travel issue (No. 7, 1955). Ri.

Beitrag zur Untersuchung von stehenden geraden Turbinengittern mit Hilfe von Druckverteilungsmessungen. — By Prof. K. Leist (No. 72 in the series of the North Rhine-Westphalian Ministry of Economics and Transport's Research Reports, issued by Prof. Leo Brandt). — Published in manuscript form by Westdeutscher Verlag, Cologne and Opladen, 1954 (German, 141 pages, DM 36.20).

The author bases his work on the fact that though the development of turbine blade systems has today reached a high level, it can still not be dealt with systematically. Above all there is no comprehensive account of the flow mechanism in axial-flow blade systems. The reason lies not only in the large number of parameters involved but also in the difficulties facing experimental investigations. — However, a simplified two-dimensional flow (plane cascade flow), more accessible to mathematical treatment, can be obtained by unrolling an axial cylinder section. In the author's opinion this would be a first step towards the investigation of blading for gas turbines. A second step would then be the investigation of rotationally symmetrical flow in and behind a fixed axial cascade and the third step an analysis of actual flow conditions in a rotating axial system.

The present report deals primarily with the first step and gives a survey of the measuring methods used for plane blade cascades: 1—blade balance ; 2—measurement of impulse changes in flow ; 3—measurement of pressure distribution in the cascade. A comparison between an earlier and two recent cascade test benches illustrates the advances made in the past few years in measuring techniques. A description is also given of the Aachen Institute of Technology's new cascade test bench, which is to be used primarily for comparative measurements with a newly-developed measuring device for rotating blade cascades (cf. step 3). Finally the results obtained by the Aachen test bed are summarized in 67 pressure distribution diagrams, with the aid of which the most important parameters for the design of turbine blades can be determined. Re.

Technical Aerodynamics (Third Edition).—By Karl D. Wood.—Printed in manuscript form and distributed by Ulrich's Book Store, Ann Arbor, Michigan, 1955 (English).

The author is Professor at the University of Colorado and head of the University's Department of Aeronautical Engineering. His book is addressed particularly to students of aircraft design to enable them to undertake performance, stability and aerodynamic design calculations. In contrast to the first two editions, the new volume concentrates on jet aircraft, guided missiles and helicopters. Starting from the fact that even today the aeronautical engineer is still working in new territory, the author summarizes empirical knowledge of flow processes in the transonic range and of mixed subsonic and supersonic flow, hot boundary layers and other problems of high-speed flight. The student is referred for additional information to the author's " Airplane Design ", last published in 1954 (a new edition is in preparation). Re.

Internationale Luftfahrtabkommen — Vol. I. — Issued by Prof. Alex Meyer in the series of publications of the Air Law Research Agency. Carl Heymanns Verlag, Cologne-Berlin, 1953 (German, 416 pages).

After the review of the second volume in this collection of international air agreements had appeared (*Interavia*, No. 5, 1955, p. 337), it was found that *Interavia* had not reviewed the first volume. However, the earlier general remarks can be extended to Volume I. Contents : transition regulations of the post-war period, Chicago Convention including transit and transport clauses, Warsaw Convention, I.A.T.A. conditions of carriage, Rome Conventions on a) seizure of aircraft as security, b) liability for damage to third parties on the surface ; Brussels agreement on assistance and salvage of aircraft at sea, Geneva agreement on the international recognition of rights in aircraft, etc. He.

Deutsche Luftfahrtgesetzgebung (2nd Edition ; July 1st, 1955). — Collected by Dr. Alfred Wegerdt. Verlag Pohl & Co., Munich, 1955 (German, 277 pages, price DM 16.80).

In reviewing the first edition of this collection of aviation legislation (*Interavia*, No. 2, 1952, p. 98) it was pointed out that the author had already published several similar collections before World War II. Although little has changed in German air law since the War, the contents of this volume have grown from 110 pages in the first edition to 277 pages in the second, a circumstance that is explained by Germany's re-entry into international aviation. He.

Gedanken über einen neuen deutschen Luftverkehr.—By Dozent Dr.-Ing. habil. E. Rössger. Published in manuscript form.—No. 195 in the series of Research Reports issued by the North Rhine-Westphalian Ministry of Economics and Transport. Published by Prof. Leo Brandt. Westdeutscher Verlag. Cologne and Opladen, 1955 (German, 330 pages).

A report, prepared for the Ministry on the " need for further expansion of the Deutsche Lufthansa ". At the same time a carefully edited, concentrated operational history of the old Lufthansa and a basic analysis, with 112 tables, of the commercial and operational situation in world air transportation. All who are concerned with air transportation will be grateful for this addition to their basic documentation. He.

Die Erde hat viele Namen. — By Ernst Schnabel. Verlag Claassen, Hamburg 1955 (German, 262 pages).

The reviewer has found few books as entertaining as the series of travel reports, originally written for the radio, by this charming aviation reporter (incidentally, he is himself a pilot). Cultured, seen with an intelligent eye and described with a masterly touch. Whether impressed by the splendour of Damascus, he forgets " to shave the other cheek "... or is being driven along the Iron Curtain by an enviably beautiful and equally dare-devil Chinese girl student... whether he describes Eskimos in Greenland or Ticinesi in Locarno, Schnabel is always good-humoured and succeeds admirably in passing on his good humour to his readers. He.

Flügel unseres Jahrhunderts.—By Heinz Gartmann.—Paul Müller, Munich, 1955 (German, 240 pages).

" The adventure of flying ", chosen by the author as sub-title, best describes the contents of this gripping book. In conversational style Heinz Gartmann reviews fifty years of flying : pioneer feats, records and technical achievements, from the jet aircraft to the annular-wing aircraft. The book mixes descriptions of commercial aircraft types, meteorological equipment, instrument landing procedures etc. with sporadic references to physical principles of flight such as lift and drag, leaving practically no subject of modern aviation untouched.—All *Interavia* readers conversant with the German language—especially the younger generation—will enjoy this book. Re.

Flug ohne Landung.—By Harry Grindel. Verlag Bechtle, Esslingen 1955 (German, 105 pages).

Another book of war reminiscences among the hundreds that have appeared in all languages, but a refreshing change from the majority because of its naturalness. Both author and his tale are engaging, as both are genuine. There is no attempt to " embroider " or to impress the reader with a display of technical or tactical knowledge. The book also contains an exciting plot, which will not be given away here. He.

Terminologia Aeronautica Angloamericana. — By Dott. Ing. N. Buiatti. Arte della Stampa, Rome. 1955 (English-Italian, 199 pages, price 4,000 lire).

The author, a lieutenant colonel attached to the Ministry of Defence " Air " Technical Services, has made a valuable contribution to international understanding with the present glossary of aeronautical terms. The book, of handy format, is based on the I.C.A.O. glossary (1952), the glossary of the British Standards Institution (1949/50/51) etc., and is divided into three parts : Part 1 : English-Italian aeronautical glossary with Italian definitions ; Part 2 : Italian-English glossary ; Part 3 : list of common abbreviations in the English aviation language. He.

Books received :

Die Verkehrsentwicklung des Landes Nordrhein-Westfalen — Jahresbericht 1954. Printed in manuscript form. Published by the North Rhine-Westphalia Minister of Economics and Transport, Düsseldorf, 1955 (German, 195 pages).

Schwingungsverhalten eines Schaufelkranzes im Vakuum. By Dr.-Ing. H. Söhngen, No. 191 in the series of research reports issued by the North Rhine-Westphalia Ministry of Economics and Transport, written for the Deutsche Versuchsanstalt für Luftfahrt e.V.—Issued by Prof. Leo Brandt.—Westdeutscher Verlag, Cologne and Opladen, 1955 (German, 24 pages, price DM 7.80).

Die Wege des Strahlfluges.—By Dr.-Ing. E. Sänger, No. 3 in the series issued by the Research Institute for the Physics of Jet Propulsion.—Verlag R. Oldenbourg, Munich, 1955 (German, 14 pages).

Erratum

In the article entitled " Trends in British Ground Air Radio Equipment " in the September issue, the range quoted for the Cossor Gee navigational aid should have been 100 to 400 nautical miles depending on altitude, thus placing it in the medium range category. — In addition, the Decca Q-band surface movement radar has a wave length of 8 mm not 8 cm.

Photo Credits : Front Cover : United Nations, Geneva ; pp. 825-832 : ATP (1), Interavia (13), Interavia records (4) ; pp. 835-838 : Howard Levy, New York (1), Manufacturers (5), Interavia (29), Interavia records (44) ; p. 839 : Interavia (8) ; pp. 840-846 : Manufacturers (5), Interavia (40) ; pp. 847-852 : United Nations, Geneva (4), ATP (5), Manufacturers (2), Interavia (2) ; pp. 853-855 : Railway Express Agency ; pp. 856-857 : Manufacturers ; pp. 858-859 : Manufacturers (2), Interavia (5) ; p. 860 : Howard Levy, New York ; pp. 861-862 : Manufacturers (7), Interavia (1) ; p. 864 : G. C. Richard.

The Mind of Mr. Reader...

Interest in high altitude research and Arctic . . .

Sir,

. . . As a subscriber I should like to take this opportunity of congratulating *Interavia* on the high quality of its publication . . . I should also like to suggest that you publish a special article on the latest results of high altitude research, if possible with particular reference to physiological problems, including the effects of weightlessness. Generally speaking, a survey of recent aero-medical development should also be interesting. Finally, I should like to see an article on Polar navigation and Arctic medicine.

Mexico City, D.F. José Maza Belmar

The Editors realize that physiological problems were somewhat neglected in the special issues on guided missiles and space ships (Nos. 5 and 7, 1955) and are actively considering the possibility of giving more attention to aeronautical medicine from time to time. The subject of Polar navigation was dealt with in No. 2 this year.

French aircraft industry overestimated ?

Sir,

Although I greatly value *Interavia* in general . . . there have quite frequently been occasions when I felt like writing to you, e.g., when like Prime Minister Faure you considerably overestimate the importance and the achievements of the French aircraft industry and suggest it has prospects which, in my opinion, it can scarcely reach within the next few years. I would mention the countless commercial transport types that have been built in France since the end of the war (and which all too frequently have not got beyond the prototype stage) . . .

Actually I set out to write to you about something quite different, namely the article " What Use are Air Shows ? " (*Interavia* No. 8, 1955), particularly the remarks on the necessity or otherwise of motor races. It seems to me the writer slightly missed the mark here. I should like to add that I am myself a car driver. Nevertheless I would immediately support a general prohibition of all motor racing, but not of air shows.

Zürich-Kloten H. Flück

Although the Editors always gave space in earlier years to justified criticism of French aeronautical development, they feel that the situation has now fundamentally changed and that today's French aircraft industry is really running " neck and neck with foreign rivals " (Interavia, No. 6, 1955, pp. 382 etc. and pp. 387 etc.; No. 8, 1955, pp. 590 etc.).

Explaining the satellite's circular orbit

Sir,

I found the July 1955 issue very interesting. I can't agree (see Footnote 1, Page 506) that " circular velocity is the speed at which weight of the body (satellite) and centrifugal force (due to the circular motion) balance one another ". The position with a body in a circular orbit is, as I see it, as follows :

To cause the body to describe a circular motion a force must act upon it in the direction of the centre of rotation. This force is known as a centripetal force ; and is provided by the gravitational attraction of the body about which the Satellite rotates. There is thus no question of a *balance* of forces on the Satellite but simply that of the action of *one* force (weight) producing a circular path in place of a straight line that would occur in the absence of that force.

Centrifugal reactions to centripetal forces occur in rotating machinery, but not in the above case.

(P.S. I put this point of view in correspondence in the B.I.S. Journal about a year ago).

Weston-super-Mare,
Somerset, England

S. W. Greenwood

The Editors agree with Mr. Greenwood's theory of the circular motion of satellites. However, they would prefer to describe the centrifugal forces on rotating parts as ACTIVE forces. Reaction forces in this case would be the centripetal stresses in the material.

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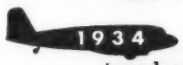
1927 KLM makes the world's first intercontinental charter flight: Amsterdam-Jakarta and -Khartoum.

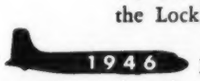
KLM opens the longest air route in the world of that time: Amsterdam-Jakarta.



KLM, as first airline outside the U.S., introduces the all-metal DC-2, wins the London-Melbourne Air Race handicap section.

1936 KLM is the first European company to purchase the world's most widely sold commercial aircraft: the DC-3.

1943 KLM, as first non-U.S. carrier, orders the Lockheed Constellation.



KLM, despite its war-shattered organization, is the first European airline company after the war to open a regular Trans-atlantic service to New York.

1948 KLM is the first European company to put the Convair Liners into service.

1950 KLM is the first European airline to be specially authorized by the U.S. Government to overhaul aircraft of U.S. airlines.

KLM is the world's first airline to operate the turbo compounded Lockheed Super Constellations.

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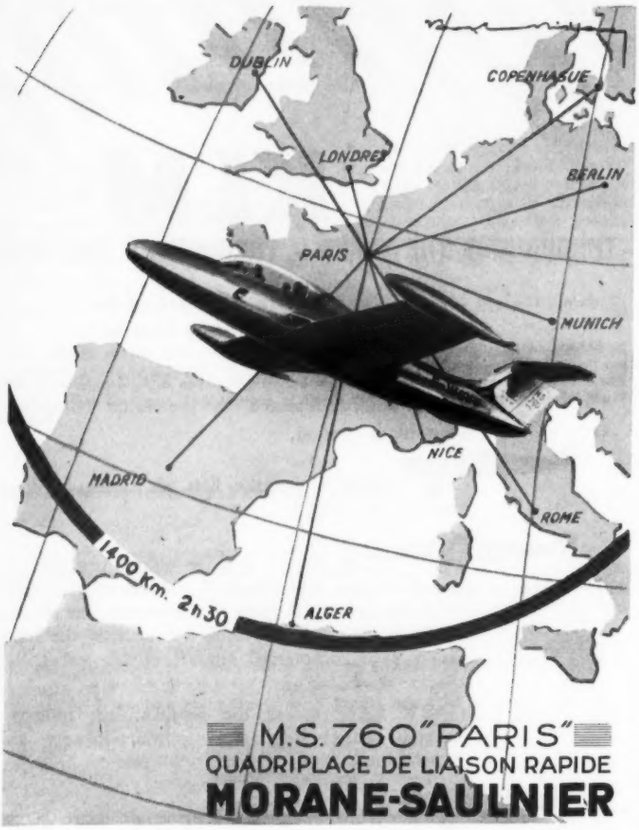

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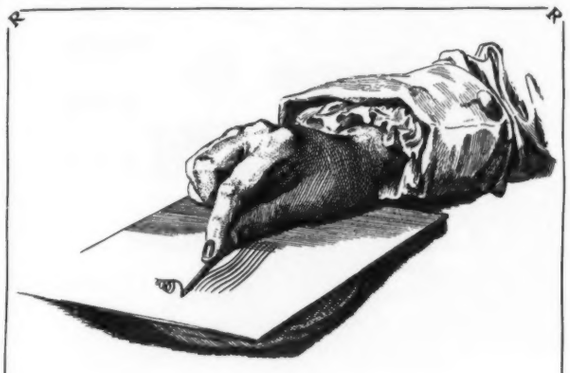

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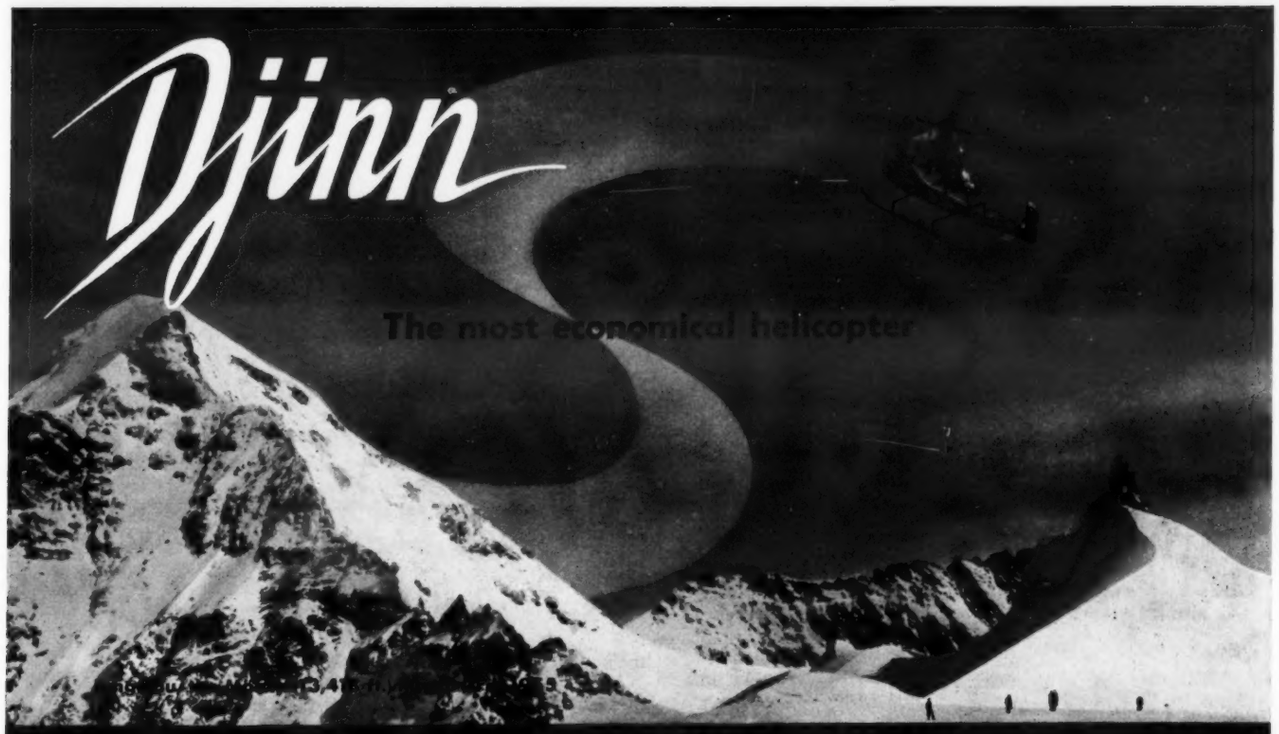

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5.

Highlights from the History of Swiss Aviation

On October 15th, 1954 Swissair ordered two of the latest type Douglas aircraft, the DC-7C—the first European airline and the second in the world to do so—having already been the first to put the DC-6B, then the most modern type, into service on the North Atlantic route in 1951. The DC-7C order was later increased to four. The first two " Seven Seas " will be delivered to Swissair before the end of 1956, and the remaining two early in 1957.

With their still-air range of roughly 5,000 miles, these newest aircraft will be able to carry a payload of more than 8 tons over the approx. 3,475-mile distance between New York and Switzerland, operating non-stop under all conditions on the West-East run and on 50 % of all flights in the East-West direction. As the DC-7C has a maximum speed of 390 m.p.h. and an average cruising speed of 295 m.p.h. (max. 315 m.p.h.), it will enable a time saving of roughly three hours to be made in each direction, compared with present schedules on the Atlantic route between Switzerland and New York. This in itself will improve travelling comfort through the elimination of intermediate landings.

Swissair will also be the first airline in Europe to fit its DC-7C with R.C.A. storm warning radar.

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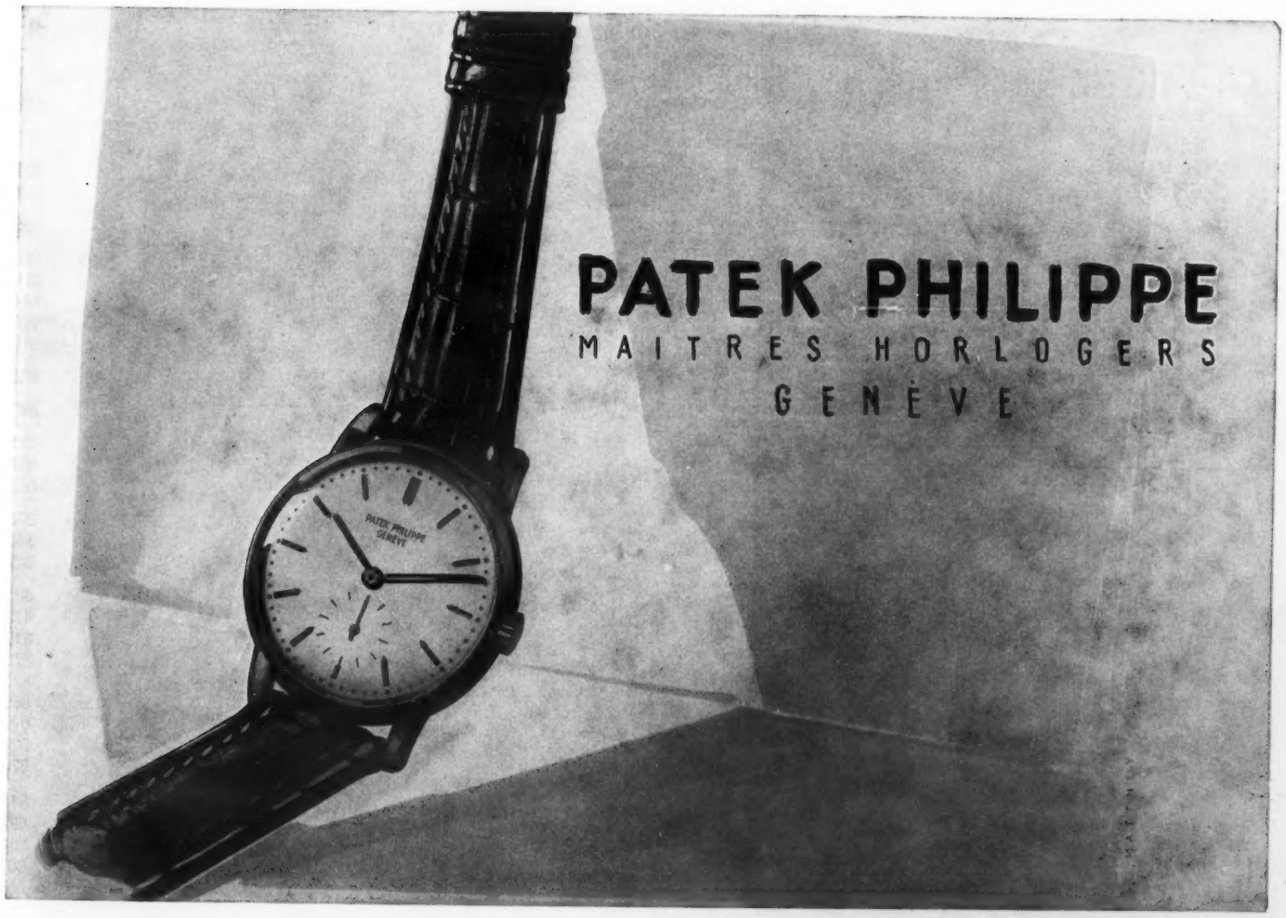
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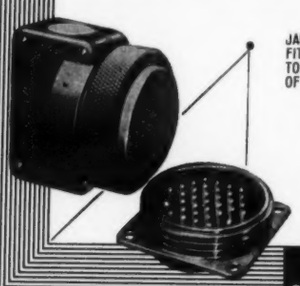
ELECTRIC MULTI-PIN PLUG AND CONNECTION



JAEGER MULTI-PIN PLUGS ENSURE THE RAPID FITTING OR DISMANTLING OF MULTIPLE-CONDUCTOR CONDUITS. THEY RULE OUT ALL POSSIBILITY OF ERROR IN THE CONNECTIONS MADE.

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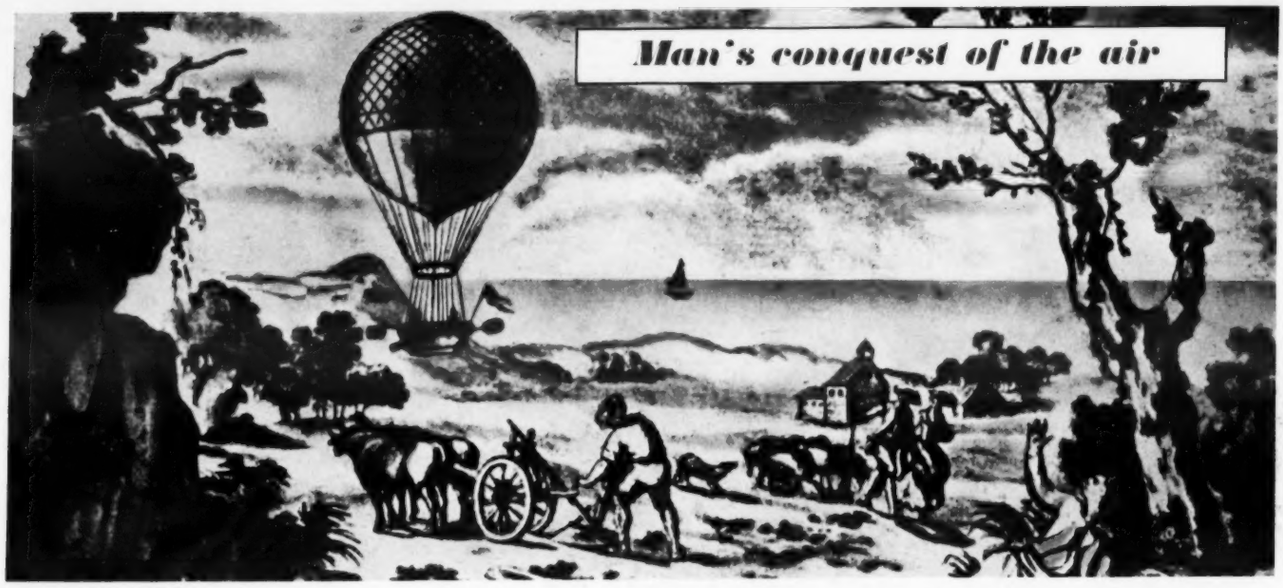


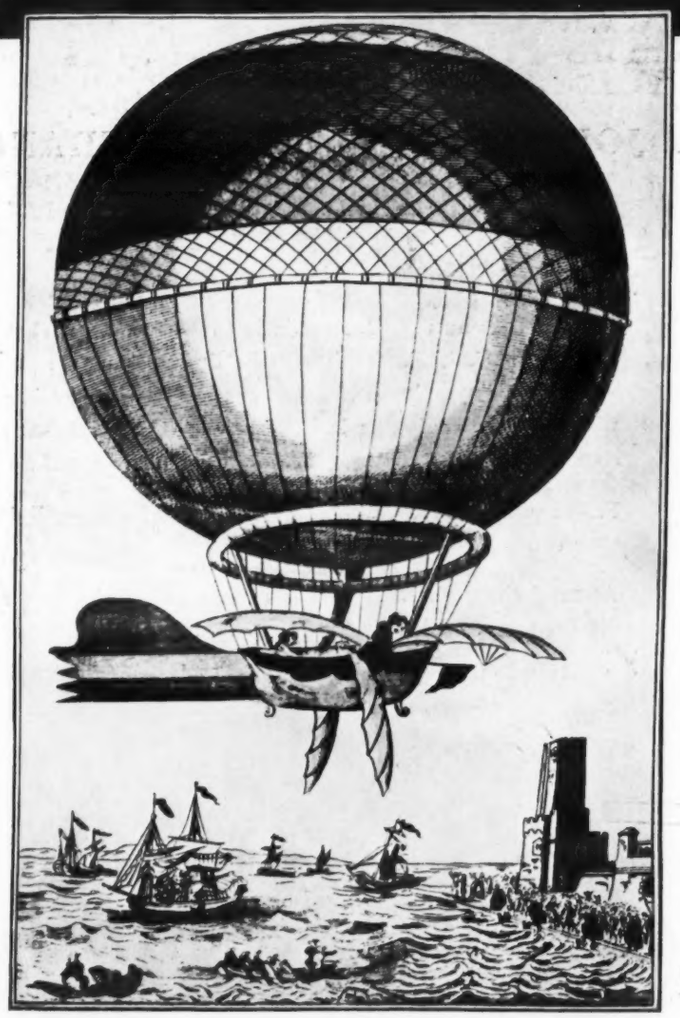
First Flight over the English Channel

"The borderline of nations is crossed in the Air! . . . The seas are no longer barriers!" This was the exciting news on January 7, 1785, when Jean Pierre Blanchard, French aeronaut, and Dr. John Jeffries, American from Boston, made the daring and hazardous first air journey across the English Channel by balloon.

As the huge gas-filled sphere rose over the cliffs of Dover, sightseers crowded the coast, as well as boats off shore, to watch this first air venture over the sea. All went well until Blanchard and Jeffries were in sight of the French coast. With one quarter of the gas lost, they began to fall fast.

In short order they threw into the sea everything from sand ballast to apples and biscuits. "Still approaching the sea, we began to strip ourselves." Jeffries reported later. Not until even Blanchard's trousers went overboard did the balloon ascend. After two hours in the air Blanchard and Jeffries landed near Calais, where they received a royal ovation.

Less than two centuries later, aircraft span the globe. And ESSO research is part of that progress, helping to supply aircraft and engine builders, operators and pilots with the new and better aviation petroleum products they need.



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